Deanship of Graduate Studies
Al-Quds University

Evaluation of the Effect of Seasonal Variation and Company Practices on Selected Quality Parameters of Commercial Drinking Yoghurt

Esraa Wael Diab Abu Meizer

M.Sc. Thesis

Jerusalem-Palestine

1446/2025

Evaluation of the Effect of Seasonal Variation and Company Practices on Selected Quality Parameters of Commercial Drinking Yoghurt

Prepared By:
Esraa Wael Diab Abu Meizer

B.Sc. : Nutrition and Food Processing. Hebron University-Palestine

Supervisor: Dr. Claude Elama
Co-supervisor: Dr. Saleh Sawalha

A thesis submitted in partial fulfilment of requirements for the degree of Master of Food Technology in Agribusiness Program, Al-Quds University

1446/2025

Al- Quds University

Deanship of Graduate Studies

Agribusiness Program

Thesis Approval

Evaluation of the Effect of Seasonal Variation and Company Practices on Selected Quality Parameters of Commercial Drinking Yoghurt

Prepared by: Esraa Wael Diab Abu Meizer

Registration No: 21820388

Supervisor: Dr. Claude Elama

Co-supervisor: Dr. Saleh Sawalha

Master thesis submitted and accepted, Date: 14/01/2025

The name and signature of the examining committee are as follows:

1- Head of the Committee: Dr. Claude El'Ama Sign…………
2- Committee member: Dr. Saleh Sawalha Sign…
3- External Examiner : Dr. Mohammad Hmiedat Sign……………
4- Internal Examiner: Dr. Ziad Ayyad Sign……..

Jerusalem-Palestine

1446/2025

Dedication

This thesis is dedicated to my beloved homeland, Palestine, and to the memory of my late mother and dear father, who instilled in me the value of self-reliant knowledge. To my cherished husband, Mohamed, who taught me that even the most challenging tasks can be accomplished one step at a time. To my supportive family, whose unwavering encouragement has been a constant source of strength throughout my academic and personal journey I also dedicate this work to my supervisors, friends, and colleagues at Al-Quds University and Hebron University, as well as to the Palestine Standards Institution and the dairy companies in Palestine, whose commitment to research and development has greatly contributed to this achievement.

Esraa Wael Diab Abu Meizer

Declaration:

I certify that this thesis submitted for the degree of master, is the result of my own research, except where otherwise acknowledged, and that this study (or any part of the same) has not been submitted for a higher degree to any other university or institution.

Signed:

Esraa Wael Diab Abu Meizer

Date: 14/01/2025

Acknowledgements

All praise and gratitude are due to God, the Almighty, for His blessings, guidance, and patience throughout this academic journey. May peace and blessings be upon the Prophet, the Messenger of God.

I would like to express my deepest gratitude to my supervisor, Dr. Claude Elama and Dr. Saleh Sawalha, for their invaluable guidance, feedback, and encouragement, which were instrumental in the completion of this research.

Special thanks to the Department of Food Engineering, especially Dr. Ziad Ayyad, Miss Lubna Abo-Khalaf, Miss Sana Jabarin, and Mr. Sameh Naseba, for their continuous support. I also thank the Pharmacy Department staff, particularly Mr. Ibrahim Ayad and his colleagues, for their assistance during the field experiments.

I am grateful to Hebron University and Mr. Wisam Sammar for his contributions to the sensorial analysis of the samples.

A special thanks to Mr. Iyad Al-Taradeh for his support and for providing a work environment that enabled me to complete the experiments in the private laboratory.

To my husband, Mohamad, my heartfelt gratitude for his unwavering support and encouragement, and to my family for their endless love and belief in me.

Lastly, I extend my thanks to my friends and everyone who contributed, directly or indirectly, to the success of this research.

Esraa W. Abu Meizer

Abstract

Drinking yoghurt is a traditional fermented dairy product widely consumed by Palestinian consumers. It is prepared by combining yoghurt, water, and salt. Yoghurt, produced from milk, water, and starter culture, is generally considered a healthy product. With industrial advancements, drinking yoghurt has become commercially available in large quantities in Palestinian markets. However, its nutritional and functional aspects have not been thoroughly researched.

This study aimed to investigate the impact of manufacturing practices and storage period on the quality parameters of drinking yoghurt from five major local commercial brands across various regions of the West Bank- Palestine (Northern, Southern, Eastern and Central Palestine). The study also examined the adherence of these products to Palestinian Specifications M.F. 18-2-2019 and CODEX STAN 243-2003, as well as the effect of seasonal variations during winter and spring.

In winter, 210 packs of yogurt drink were acquired, and in spring, 180 packs were obtained from Al-Shini Extra shop. 6 packs from each brand were randomly selected for sensorial evaluation and were examined just in winter. In both seasons, from the entire purchased batch, 6 packs were randomly selected for physicochemical and rheological tests from each brand, and this group was designated as a control group. In addition, 6 randomly selected yogurt drink packs from each brand were subjected to microbiological tests, and the rest of the samples were refrigerated at 4 °C. Key quality parameters assessed included physicochemical properties such as pH, acidity, and chemical composition (solids, fat, solid non-fat, protein, ash, and minerals, including sodium, potassium, calcium, magnesium, and salt content). Rheological properties, including viscosity, density, serum separation, and water-holding capacity, were also evaluated. Microbiological criteria, including the presence of food pollutants and spoilage pathogens such as total coliform bacteria, fecal bacteria, yeasts, molds, total plate count (TPC), and Lactic Acid Bacteria (LAB), were examined. All testing and evaluations were performed in accordance with established AOAC guidelines for evaluating Palestinian consumer preferences.

The study revealed significant seasonal variations ($P<0.05$) in the tested parameters, including pH, acidity, chemical composition (moisture, solids, protein, non-fat solids, ash, and minerals), rheological properties, and microbial growth. Non-significant differences were observed in fat content, salt percentage, and lactic acid bacteria count. These findings suggest that companies may effectively control the levels of added salt, starter cultures, and milk fat percentage, ensuring minimal microbial contamination and maintaining health standards during production.

Furthermore, manufacturing practices, geographical differences, and brand variations significantly impacted the quality of the product ($P<0.05$). Sixty percent of Companies possess products that conform to Palestinian and international standards.. Significant changes ($P<0.05$) were observed in the physicochemical, rheological, and microbiological properties of the yoghurt during its shelf life at 4±1°C. Most of the investigated companies exhibited higher levels of bacterial, yeast, and mold growth.

Based on the findings, it is recommended that manufacturers follow Good Manufacturing Practices (GMP), implement Hazard Analysis Critical Control Points (HACCP), and ensure

proper storage and transportation conditions to preserve product quality. The use of sorbates and other preservatives should be discontinued, and products should comply with both Palestinian and international technical standards. Furthermore, it is crucial to ensure that product labels accurately reflect the ingredients and information.

Finally, to ensure that Palestinian dairy products meet international and national standards, governmental bodies should enhance their oversight of the food industry. Further research is necessary to examine individual quality parameters (physicochemical, chemical, rheological, microbiological, and sensory) in more detail, as well as to study the impact of storage temperature and seasonal fluctuations on product quality.

List of Contents

List of Tables

List of Figures

List of Appendices

Abbreviations

AOAC: Association of Official Agricultural Chemists
BAM: Bacteriological Analytical Manual.
CH: Casein Hydro lysate.
CFU: Colony Forming Unit
DM: Dry Matter.
FAO: Food and Agriculture Organization.
FDA: Food and Drug Administration.
GMP: Good Manufacturing Practices.
HACCP: Hazard Analysis Critical Control Point
IEP : Iso-Electric Point.
MPC: Milk Protein Concentration.
NAFDAC: National Agency of Food and Drug Administration Control
PCBS: Palestinian Central Bureau of Statistics.
PSI: Palestinian Standard Institution.
DY: Drinking Yogurt.
SMP: Skim Milk Powder.
SNF: solid Non Fat.
TA: Titratable Acidity.
TPC: Total Plate Count.
TC: Total Coliform.
TS: Total Solid.
LAB: Lactic Acid Bacteria.
VSM: Value Stream Mapping.
WHC: Water Holding Capacity.
WHO:World Heath Orgznization.

Chapter One

Introduction

1.1 Introduction:

Yoghurt and yoghurt related drinks and beverages (Smoothie, Makheid, Shanina, Ayran, Kefir, Doogh and Koumiss) have different names in different countries, for instance, “Makheid” in Palestine and Morocco, “Shanina” in Jordan, “Doogh” in Iran, "Ayran" in Turkey and “Lassi” in India (Esfandiari *et al.,* 2016) and it has a very long history of being in the homemade foods category.

Dairy products in the local market account for 80% of the Palestinian market share with an investment value of $70 million. There are 41 factories registered with the Ministry of National Economy working in the dairy sector, and they employ about 3,000 workers, directly and indirectly, from farmers, manufacturers of plastic bottles, veterinarians and others. According to the statistics of the General Federation of Food Industries, the capacity of dairy factories is 550-600 tons per day, and basic commodities such as yoghurt, yogurt and white cheese cover about 90% of the Palestinian market, which is essential in the dairy sector. Dairy factories export more than $6 million worth of dairy products annually. West Bank governorates produce about 70 million liters of cow milk annually, while in the Gaza Strip about 19 million liters of cow milk annually. (Alwatanvoice, 2018,The Palestinian Information center, 2018).

In 2018, the dairy industry's production value was $135.5 million, or 17% of the food industry overall. ($128.1) million, the most of which are located in the West Bank, account for around 83.4 percent of the dairy industry's output. and ($25.4) million make up around 16.6% of the dairy business in the Gaza Strip (PCBS, 2020).

In recent years, yogurt has become prevalent in dairy fermented food in the market. The trend of yogurt consumption is gradually increasing with customer warness on healthy diet. Yogurt is used throughout the year however; an increased consumption of yogurt is observed in summer (67%) as compared to winters and at other times of the year almost (33%) (Raza *et al.,* 2020). Drinking yougurt contains salt and water, two substances that the body loses in the heat season due to sweating, hence drinking yoghurt is the most successful drink to maintain the balance of fluids and salts in the body (Köksoy & Kılıç, 2003).

The production of drinkable yogurt in the Palestinian market is considered one of the important dairy products manufacturing sector, as it constitutes approximately 20% of dairy product. Because its a traditional product that is easy to consume and has important nutrients like minerals, water, fat, protein, and carbohydrates. The popularity of drinkable yogurt is attributed to its easy consumption and unique taste passed down through generations (Dikmen & Filazi, 2021).

Currently, Palestinian industry produces around 50-60 tons of drinkable yogurt daily for local markets, due to its high profit margin, as it contains approximately 30-50% added water. The price of fresh raw cow's milk reaches ($0.767) including tax, while the price of one liter of drinkable yogurt is ($2.35) according to the national manufacturing companies (Sales report at Al-Juniedi company, May, 2024).

1.2 Background:

Dairy products are among the most widely consumed foods globally, with yogurt being one of the most popular choices. The sensory qualities of yogurt play a significant role in its acceptance by consumers (Saint-Eve *et al.,* 2006). Yogurt has been a part of the human diet for several millennia and goes by many names throughout the world. The word "yogurt" is believed to have come from the Turkish word "yoğurmak," which means to thicken, coagulate, or curdle. While references to the health-promoting properties of yogurt date back to 6000 BC in Indian Ayurvedic scripts, it was not until the 20th century that Stamen Grigorov, a Bulgarian medical student, attributed its benefits to lactic acid bacteria. Yoghurt is a fermented milk that is acidified with viable and well-defined bacteria (*Lactobacillus bulgaricus* and *Streptococcus thermophiles*) (Fisberg & Machado, 2015). The Nobel prize winner Russian bacteriologist Ilya Metchnikoff was the first researcher who conducted scientific research on yoghurt, yoghurt beverages, and their connection to human longevity. Yoghurt retains 50% of the cultured product market sales, which comprises cottage cheese, fermented beverages (drinkable yoghurts and kefir), refrigerated dips, sour cream, and yoghurt (Thompson *et al.,* 2007).

Throughout history, civilizations like the Sumerians in Mesopotamia and the Pharaohs in northeast Africa, among others, practiced milk preservation through fermentation long before the Phoenician era possibly originating even earlier in the Middle East region where records are scarce dating back as long as 10,000–15,000 years ago. References to fermented milk products, like laban rayeb and laban khad were consumed in Ancient Egypt around 7000BC according to Kosikowski & Mistry (1997). The Rig Veda and Upanishad (Indo Aryan texts) discussed dadhi (an ancient fermented milk product similar to today’s yogurt) around 5000 years BC. Dadhi was recommended as a remedy, with healing properties

(Bintisis & Papademas 2022). In Asia it is believed that yogurt was first made by the Turks. Aladjadjian *et al*, (2016) have shown that Balkan states were the first to prepare yogurt. Sour milk, or prokish, by Thrace villagers from sheep milk. The areas listed below have the largest worldwide consumption of fermented dairy kinds (including yogurt): South Asian areas include India, Pakistan, Nepal, and Bangladesh, as well as southwest Asian territories such as Iran, Iraq, the Balkans, Turkey, and Syria. It is thought that the attack and invasion of Mongols, Tatars, and other Asian heads into Russia and Europe resulted in the advent and spread of yogurt and other fermented milk over the world (Buell *et al*, 2020). Yogurt is now a widespread commodity and a staple food for many different cultures throughout the world, including Europe, Australia, and others. Yogurt and other fermented dairy products are commonly produced in many countries around the world today. The traditional methods used to make yogurt, for consumption are still widely practiced in various regions (Chandan & Shah, 2017).

Yogurt consumption varies widely per country, although it is generally modest. Reduced yogurt intake means less contribution to a healthy lifestyle (Fisberg & Machado, 2015). Today, several dairy drinks are offered over the world. According to (Özer & Kirmaci, 2010), dairy drinks are still a niche sector compared to yogurt and plain milk sales. Functional dairy beverages with probiotics and/or prebiotics are the most prevalent. Dairy-based functional foods account for around 43% of the market, with fermented dairy products accounting for nearly all of it. In 2005, the global value of functional foods was $16 billion. Yogurt has a distinct flavor and nutritional value, and there are several variants available, including natural plan yogurt, yoghurt with fruits, pasteurized and sterilized yoghurts, dried yoghurts, frozen yoghurts, instant yoghurt, acidophilus yoghurt, liquid yoghurt, and many more. It may be eaten as the main course for breakfast, lunch, or supper. In addition to being used as a snack, as a beverage and added to various kinds of salads and vegetable meals. (Aryana and Olson, 2017).

1.2.1 Drinking Yogurt Industries:

Traditional process of making drinking yogurt involves using "*Sa'an*" or " *Ssameel*" to produce "*Mukhied*" a form of Buttermilk . The “Sa’an” is made of goatskin leather. It comes in two sizes, medium and small. It is used to shake milk. The manufacture of *Sa'an*" involves three main stages, the first of which is: After the process of slaughtering the sheep, the skin is completely and correctly skinned, taking into account that the skin is not scratched with the knife, After that, flour and salt are added to the skin, and rubbed over the skin correctly in order to remove the remnants of grease and odors, and left for three days, after which it is washed well, then rewashed and placed in water mixed with “Al-Dabbagh” until the skin softens, then stirred (Azene *et al*, 2015). The skin, with the animal’s hair is outward, is rubbed with “salt”, to hold the skin, and after a period of more than two days the existing hair begins to shed and the smell of fat dissipate. Finally, the *Sa'an* is sewn using a needle called *Makhiet* and a strong thread known as *Maseis*, ensuring a tight closure. The finished product is then hung and ready for use in shaking milk. It is also used to store foodstuffs such as “milk products” and meat, and it is called “Quarter” (Shoabkeh, 2022).

Fig. (1.1): Traditional "***Sa'an***" utilized in the churning of yogurt and the production of buttermilk " ***Mukhied*** "(Shoabkeh, 2022).

Mostly, farmers used sheep and goat milk , and rarely used cow's milk to make Mukheid. During the process of preparing the sa'an, the farmer starts the process of preparing the milk after milking and then filtering it from the impurities, followed by boiling well, then placing it in a pot for culturing and curing with Drinking yoghurt "*Rayeb* " the cultured milk will be covered with a piece of white cloth "Shash" and then it is lift up and hang on the wall or on a tree (Mefleh *et al*, 2022). On the morning of the second day, the "robe" is placed in the sa'an and hung on three oak woods, which are placed in a pyramidal shape and form the stirrup to carry the sa'an, and watered milk. The stirring phase begins to extract butter, buttermilk, "Al-Shanina" used for jameed making. The process of churning the milk requires patience, and depends on the physical strength of churning and shaking the sa'an, placing it in front of the eyes and pushing it forward and backward for a while, until it is ascertained that the butter is formed (Shoabkeh, 2022). If a heard sound "Khash-khasha" inside the sa'an, this indicates that the buttermilk "Shanina" is ready. Finally, the product is placed in the bowl, then butter is drained the buttermilk is put in another bowl.

Nowadays, Palestinian countryside, villages and farms are using modern techniques for making buttermilk from milk, which include turning milk into yoghurt "Rayeb", and then shaking the yoghurt in a special designed washing machine, so that the Shaneina is separated from the butter and the product called buttermilk "*Mukheid* or *Shanina*".

Recently, modern production of drinking yogurt (DY) has shifted to factory-based methods using advanced technology. Unlike traditional practices, this process starts with fresh cow's milk that meets Palestinian standards for physicochemical, sensory, and microbial quality, Approved additives and stabilizers are then added into the milk, followed by pasteurization and homogenization according to the type of pasteurizer and pasteurization process approved in the factories. Starter culutres are added according to an approved procedure in each factory using either"mother starter cultre, bulk set culture or direct starter culture" and is incubated at a temperature of 40-45ºC for a period of approximately 3-8 hours to ferment yoghurt. Finally, salt is added and active cooling stirring are applied on the tanks. The drinking yoghurt will be ready for filling on sterile and clean machines, then stored in refrigerated warehouses at 4ºC and distributed to consumers ensuring high quality and high nutritional value.

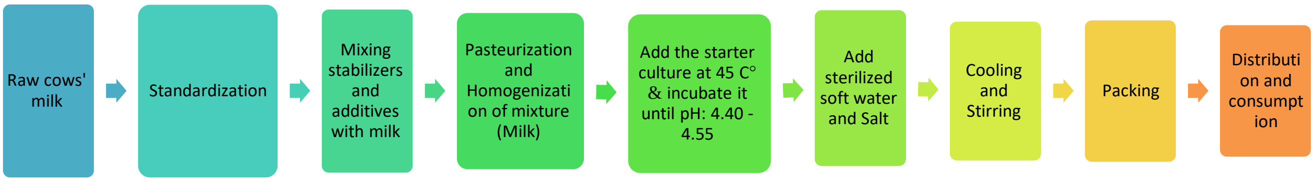


Figure 1.2 : Flowchart for making industrial drinking yoghurt (Khan et al,2024)

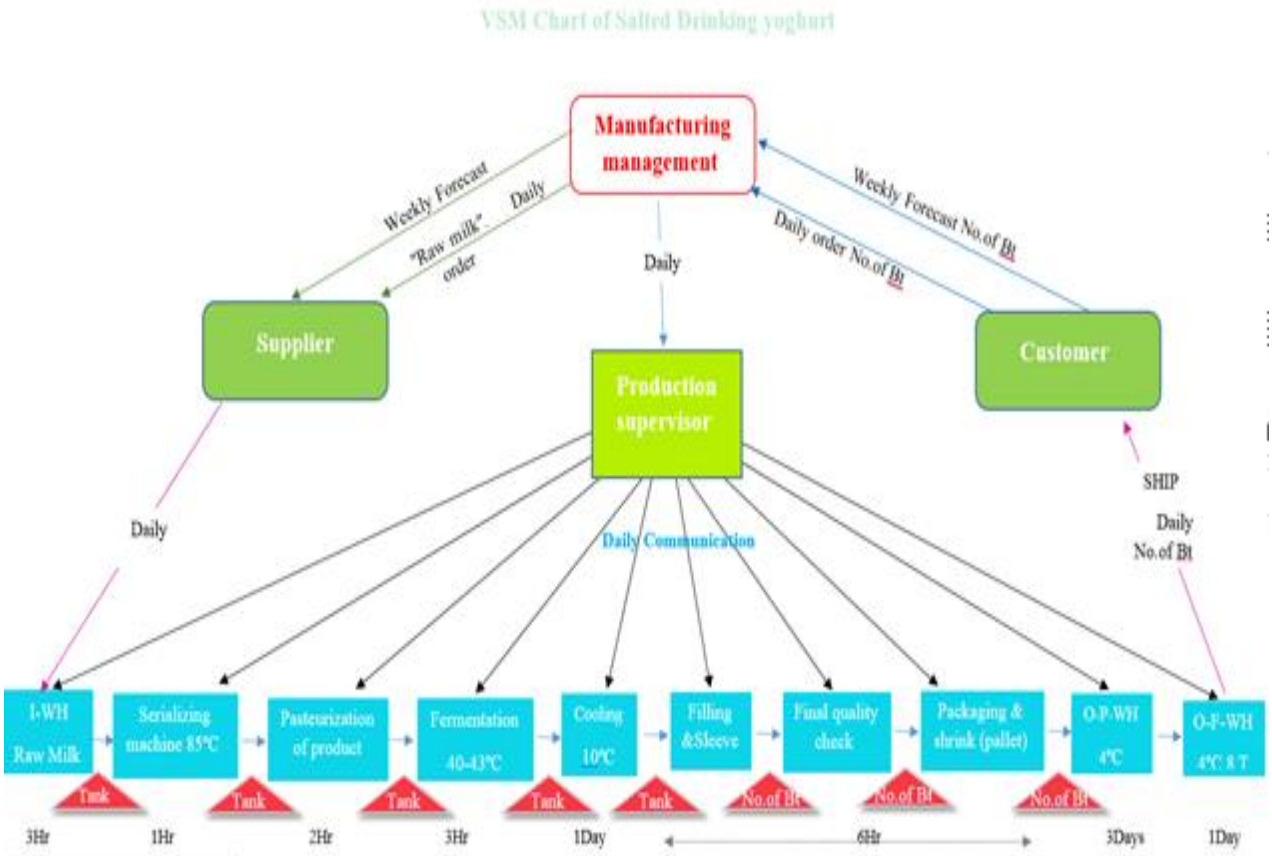


Figure 1.3: VSM chart of industrial drinking yogurt (Hakimi et al, 2018).

1.2.2 Drinking Yoghurt Characteristics:

Yogurt is one of the most extensively fermented dairy products consumed worldwide due to sensory properties that influence customer acceptance and preference (Allgeyer *et al.*, 2010). As the popularity of yogurt products grows, food manufacturers are increasingly looking for added-value ingredients such as prebiotics and probiotics to tempt health-conscious customers. Probiotics are defined as "live microorganisms, which when administered in adequate amounts confer a health benefit on the host" (FAO/WHO, 2001; Hotel & Cordoba, 2001). Furthermore, yogurt represented $51 billion in worldwide expenditure in 2011, whereas Switzerland and Saudi Arabia out of the principal per head yogurt consumers internationally set the financial record for 28.8 and 22.1 kg of yogurt per person per year in 2008 (Weerathilake et al, 2014).

According to (Kabak and Dobson, 2011), the kind of milk used, the effectiveness of fat removal, and the degree of dilution all affect the chemical makeup of salted sipping yoghurt. If yogurt is the source of drinking yoghurt, it is made by mixing yogurt with 30–50% water and 0.5–1% salt (Köksoy and Kilic, 2003).

There are two ways that drinking yogurt can be produced industrially. Water can be added to yogurt, or added to milk, then diluted milk is fermented (Kocak and Avsar, 2009; Kocak et al., 2006). The initial step involves standardizing the fat content of raw milk (1.5% for full fat, 0.8% for half-fat, and 0.15% for fat free). The first approach involves diluting standardized milk with water to a final solid content of 8%. Water is added after milk has been homogenized and pasteurized (Kocak and Avsar, 2009). Drinking yoghurt with high microbiological purity may be obtained by pasteurization (Kocak and Avsar, 2009; Sen and Küplülü, 2004). Yogurt starter cultures, namely *Streptococcus thermophilus* and *L. delbrueckii ssp. Bulgaricus*, are added to pasteurized milk and allowed to incubate until a pH of 4.2–4.4 is reached (Motawee and Neveen, 2016). To stop fermentation and prevent acidity development, the fermented samples then chilled (Köksoy and Kilic, 2003; Kocak and Avsar, 2009) to temperature 4C$^{\circ}$. In the second approach, enough water is added to the fermented milk until the sample's total solid content reaches 8%. Salt (0.5%) is then added.

Before adding additional ingredients, non-fat yogurt (<0.5%), low-fat yogurt (2%), or yogurt (>3.25%) must meet the Food and Drug Administration's (FDA, 2008) standard of identity for yogurt beverages, which also stipulates that milk solids cannot exceed 8.25%. (Chandan, 2006). Since yogurt is a great source of calcium, a good to exceptional source of highly bio-available protein, and a source of probiotics, which may have a number of health advantages.

Yogurt and milk are quite similar in terms of their nutritional profiles. Sometimes an additional ingredient, such fruit pulp, cereal, or other ingredients, causes the nutritional makeup to change. Yogurt, however, is a rich source of protein, though the amount found in it varies depending on the type (Ballew *et al.*, 2000). Yogurt also contains vitamins, minerals, and niacin (vitamin B3), folate (vitamin B9), thiamin (vitamin B1), riboflavin (vitamin B2), and zinc (vitamin B12). On the other hand, the vitamins and minerals in milk and dairy products are readily absorbed by the body, and the proteins in yoghurt have high biological value (i.e., they include all the amino acids necessary for good health) (Mckinley, 2005).

It is described as a drinkable, liquid yoghurt made from dairy milk that may or may not have fruit or fruit flavouring. Yogurt consumption, which is categorized as low viscosity stirred yogurt, is becoming more popular because to its adaptability, appropriateness, health benefits, and nutritional advantages (Allgeyer *et al.*, 2010). Additionally, drinkable yoghurts satisfy customer desire for hand-held, travel-friendly meals and snacks. They are also thought to have all the nutritional and physiological advantages of traditional yogurt (Eder, 2003). Yogurt's beneficial effects on the gut may help reduce diarrhea, boost lactose intolerance in vulnerable people, lower the risk of colon cancer, stop carcinogen-induced DNA damage, boost immunity, and lower serum cholesterol levels (Seppo et al., 2003).

1.2.3 Ingredients and Additives in DY:

1.2.3.1 Fresh Cow's Milk

As the sole diet available to animals during their first few months of existence, milk is a complex food that is full of nutrients that are vital to a baby's body. The components in milk also give off energy and act as antibodies to ward against illness. The body needs milk and dairy products to meet certain requirements, including those for calcium, magnesium, selenium, riboflavin, vitamin B12, and pantothenic acid (vitamin B5).Water, fat, proteins, lactose (milk sugar), minerals (salts), and trace amounts of other substances such pigments, enzymes, vitamins, phospholipids (which have qualities similar to fat), and gases are the primary elements of milk (Bylund, 2003).

Because of their size, resilience, social behavior, habits, and ability to adapt to their environment, goats and sheep were the first domesticated animals in the Middle East. Goats and sheep have been used for food (meat and milk) and clothing (hair and wool) for many millennia (Balthazar *et al.*, 2017). Since milk has long been considered a desirable and useful source of nutrition, herds of dairy breeds have been gathered and chosen (Yildiz 2010; Barłowska et *al*. 2011).

The cow, which is the most widely used dairy cattel worldwide and can be found on every continent, accounted for 782 million tons of the world's milk output in 2013 (Ratnakaran, 2016). As a result, cattle provide 85% of the world's milk, with buffalo (11%), goats (2.3%), sheep (1.4%), and camels (0.2%) coming in second and third, respectively (FAO, 2015). These animals' milk is incredibly important to rural communities as a source of high-quality protein and other ingredients. Goats and sheep are uncommon in regions like the Mediterranean and a sizable portion of Asia and Africa (Bylund, 2003).

Table (1.1):The composition of milk (g/100g) of different species (Bylund, 2003):

Speices	Water	Fat	Casein	Lactose	Ash	Whey protein
Cow	87.3	4.4	2.8	4.6	0.7	0.6
Buffalo	82.2	7.8	3.2	4.9	0.8	0.6
Sheep	82.0	7.6	3.9	4.8	0.9	0.7
Goat	86.7	4.5	2.6	4.4	0.8	0.6
Human	87.1	4.6	0.4	6.8	0.2	0.7

Numerous factors influence the composition of milk, with feeding, directly impacting the concentration of milk protein and fat. Other factors such as Seasonal changes, climate, temperature, and environment as well as the lactation stage, location, breed, species, milking system, age of the animal, size, and environment, also impact the quality of dairy products (Kabil et al,2015 and the composition of milk such as lactose, minerals, fat, and protein. These factors also have an impact on the kind and quality of feed that is readily available. Dietary changes have an approximate 3.0 percentage unit impact on fat and a 0.60 percentage unit impact on milk protein concentration; lactose, minerals, and other solid milk components are typically unaffected (Waldner *et al*., 2007).

These factors also play an important role in milk yield and component percentages. While milk production tends to be higher in Summer than in fall and winter production, fat and protein percentages are generally lower during warmer months (Quist et al., 2008). The light-to-dark ratio can also cause significant variations in milk yield and composition, which results in lower fat and protein contents. This is most likely due to increased prolactin secretion, which occurs when plasma concentration is higher in the summer than it is in the winter (Banasal *et al.*,2009).

1.2.3.2 Water:

Water is a fundamental element in the food processing business. utilized extensively as a processing aid and for cleaning operations in the majority of food factories. Additionally, since it's an ingredient in food, the quality of the water—that is, its impurities—can have an impact on the properties, quality, and health of the food products as well as the consumers. These include the food products' chemical composition, bioactive qualities, crystallization characteristics, anti-nutritional components, aromatic composition, and product characteristics like texture, hardness, and shelf stability as well as their appearance, color, smell, turbidity, flavor, and mouthfeel (Robert, 2017; Akan and Bayram, 2021). When employed as a processing aid, water purity has an impact on how well it dissolves, rinses, dilutes, separates, heats, cools, disperses, conveys, blankets, generates steam, and performs other operations. Hardness, or the concentration of minerals in water, always decreases the water's capacity to dissolve and distribute food components. Water is used as a solvent, diluent, transporting agent, and dispersion in food industry cleaning procedures. The primary ingredient in terms of quantity and importance is water, which comes in second only to the distinctive element of food items. Water is an excellent solvent that interacts with other food ingredients through hydrogen bonding, hydrophilic and hydrophobic interactions, and a variety of other significant activities that alter the properties of both the food and the water (Kasaai, 2014).

The three primary quality factors of water were pH, hardness, and mineral content. These are important characteristics of water because they may alter the physio-chemical, sensory, and textural qualities of food products when they seep into them. Moreover, starch and other stabilizers', protein denaturation and gelatinization are impacted by the acidity of the water (Akan & Bayram, 2021). Water might have an impact on drinking yogurt quality during storage, such as an increase in synersis and a decrease in consistency index (water separation). Since drinking yogurt (ayran), is usually made by combining 30 to 50 grams of yoghurt per 100 grams of water (TSE, 1982). Ayran's flow behavior altered from non-Newtonian with shear thinning and thixotropy to Newtonian in the shear rate range of 5–20 s-1 when large volumes of water (50 g/100 g) were added; this resulted in higher serum sepration and a fall in consistency index (Koksoy and Kilic, 2003).

1.2.3.3 Salt – sodium chloride:

Due to sodium chloride capacity to enhance food shelf life, cure, preserve, and season food as well as impact sensory attributes (such as consistency, color, texture, taste,...), it is a crucial element in food preparation. (2018, Thompson). The global daily salt chloride consumption is significantly higher than the WHO-recommended threshold of 5 g NaCl/day (Rybicka and Nunes, 2022). Ayran is traditionally made by combining yoghurt with 0.5–1.0g of salt per 100g to improve flavor (TSE, 1982). Similarly, the rheological characteristics and serum separation were impacted by the addition of salt. Ayran's flow behavior changed from non-Newtonian with shear thinning and thixotropy to Newtonian in the shear rate range of 5–20 s-1 at the addition of high salt concentrations (1 g/100 g). (Kilic and Koksoy, 2003).

1.2.3.4 Starter Culture:

Consumers increasingly seek products made by fermenting lactose to lactic acid due to their improved taste, texture, and added ideal physiological effects and health value as a result of the presence of viable cells. Starter cultures such as *Lactobacillus acidophilus, Bifidobacterium, Lactobacillus casei, Streptococcus thermophilous, Lactobacillus rhamnosus, Enterococcus faecium/ Enterococcus faecalis, Saccharomyces Cerevisiae var.boulardii, Lactobacillus gassereri* are essential in the production of fermented dairy products, such as yogurt, sour cream, and cheeses, and others (Dehghan *et al*, 2018). The Production of fermented foods is where lactic acid bacteria are most frequently employed, and they are especially important for functional foods like probiotics. Consuming fermented foods high in probiotics has several health benefits, such as enhancing and strengthening the immune system, producing antimicrobial compounds, releasing bioactive compounds, producing bacteriocins, reducing the symptoms of lactose intolerance, and lowering the risk of developing certain cancers. Starter cultures may create biomolecules and metabolites that support the autophagy that all of these processes carry out, food security is ensured (Worku *et al.,* 2020).

The texture of the fermented dairy product is influenced by the strains present in a number of different ways. First, exopolysaccharide (EPS) production—a viscosifying agent—is produced (Widyastuti *et al.*, 2014). On the other hand, SC helps in milk coagulation by neutralizing the negative charges on the milk proteins brought on by the homogeneous fermentation of lactic acid (Yang *et al.,* 2014). Such process also creates a three-dimensional protein network during fermentation, which gives yoghurt its semisolid texture (Hassan *et al.*, 1996). At a pH of about 5.6, an elastic gel structure with a solid-like behavior forms as a result of the solubilization of colloidal calcium phosphate, which modifies the micelle's structure. Yogurt's structure is preserved by a continuous protein network that is formed as the pH drops and causes the casein molecules to become more intricately and comprehensively interconnected (Vedamuthu, 2013). Additionally, heterogeneous species generates acetic acid, ethanol, and carbon dioxide in addition to producing high amounts of L (+)-lactic acid effectively from *Lactobacillus paracasei subsp. paracasei* CHB2121 (Zalán *et al.,* 2010). Additionally, Starter cultures produce bacteriocins, which are substances of protein structure that are either proteins or polypeptides as antimicrobial metabolites to produce during the primary phase of bacterial growth, they also play a significant role in food preservation and act as a safe natural preservative in dairy products (Zacharof and Lovitt, 2012). Drinking yogurt which is mild acidic, fresh, and pleasant taste is further influenced by its proteolytic, lypolytic, and glycolytic actions. *Lactobacillus bulgaricus* and *Streptococcus thermophilus* work together to produce volatile metabolites that affect yogurt's flavor and taste. Further more SC release amino and organic acids, which results in the production of lactic acid, which is the primary ingredient in yogurt, as well as other important aromatic compounds like butanoic acid, propanoic acid, acetic acid, and diacetyl (Routray and Mishra, 2011).

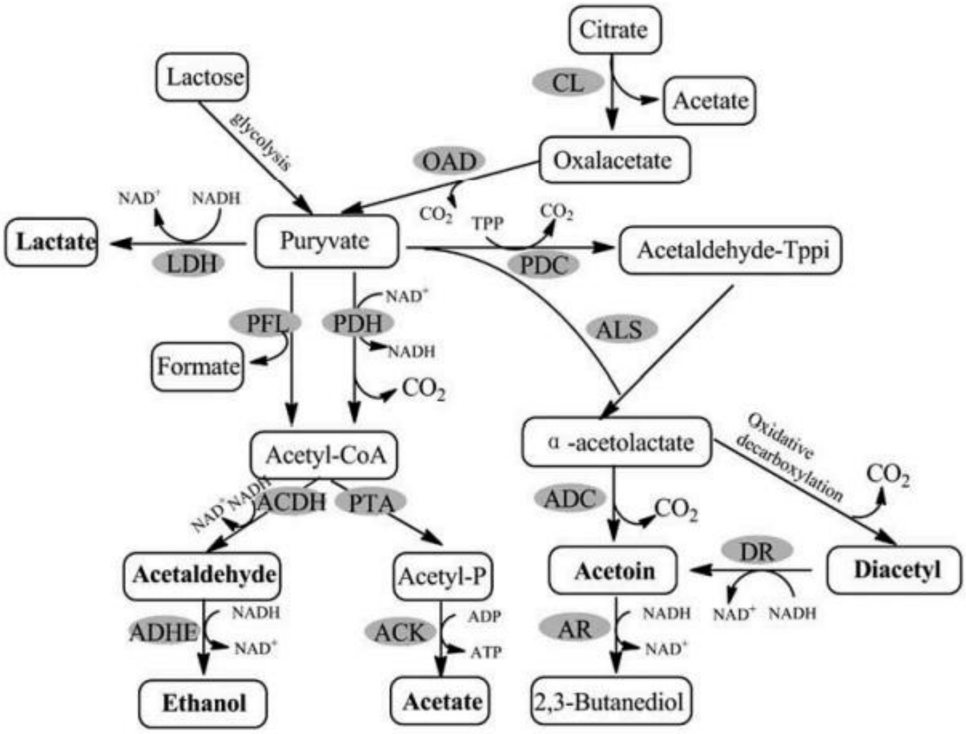


Figure 1.4 : Diagram showing the primary flavor compounds from broad metabolic pathways are formed during the fermentation of carbohydrates by LAB (Chen et al., 2017).

1.2.3.5 Stabilizers:

Food additives, or stabilizers, are necessary ingredients in the food industry. Stabilizers improve the texture of food by dispersing two or more incompatible ingredients uniformly. Following their inclusion, food items retain their well-maintained physicochemical characteristics. In addition to serving as nanostructures to control, retain, and intensify the existing body, color, mouthfeel, and flavor of food items, stabilizers also play a significant role as hydrocollidal agents, thickening agents, and gelling agents. Stabilizers are typically used to stabilize products and enhance rheological properities through basic stabilization, thickening, and improvements in texture and product appearance such as viscosity, smoothness, thickness, and structural resistance to stress (Tasneem *et al.*, 2014). Moreover, food-grade stabilizers work by preventing microbial development to extend the shelf life of food products (Everett & McLeod, 2005). Consequently, the kind of stabilizer utilized will have an effect on the product's nutritional and caloric content (Descamps *et al.,* 1986).

The choice of stabilizer is influenced by a number of factors, such as the kind, acidity, and nature of food products, hydocollidal and gelling agents, the stabiliser's functional properties such as pH, temperature, setting and adding times, concentration used, type and classification of stabilizers used, intended use and outcome, interactions with other components, equipment and process conditions, and legal aspects. (Phillips and Williams, 2000).

Certain stabilizers, such as "Agar agar E406, Arabic gum E414, Carragenan E407, Guar gum E412, Sodium carboxymethylcelulose (cellulose gum) E466 and Xanthan gum E415 could be used up to 5ppm" and "Pectins E440 could be used up to 10ppm," were permitted under SP 18-2-2004. It is recommended to utilize Good Manufacturing Process with all of these stabilizers (CODEX Stand 243-2003).

1.2.3.6 Preservatives –Sorbic Acid:

With the rise in convenience foods and processed food manufacturing, food preservatives have become an increasingly important tool in modern food technology (Saad *et al.*, 2005). These preservatives are added to food to extend its shelf life, ensure its quality, and prevent microbiological, enzymatic, or chemical food losses. (Mota *et al.*, 2003). Benzoic and sorbic acids, nitrate, and nitrite are the most widely utilized preservatives in practically all foods (Javanmardi *et al.*,2015). Food preservatives have traditionally raised concerns for consumers about their health and safety (Pylypiw & Grether, 2000). For these reasons, particular limitations restrict the use of food additives in practically all countries (Tfouni & Toledo, 2002). Legislation permitting the use of these preservatives requires particular consideration (Ferreira *et al.,* 2000).

Numerous foods and beverages, including cheese, flour products like pastries and partially cooked bakery goods, fruit and vegetable pickles, candied or salad dressings, meat products, fish products, and soft drinks and fruit juices, contain sorbic acid and its salts, sodium, potassium, and calcium (E201, E202, and E203, respectively).On non-ionized formats, this acid exhibits antibacterial properties (Silva & Lidon, 2016). These acids penetrate past the cell wall, having an impact on the death of cells. Sorbic acid metabolism generally has a less harmful effect on people than benzoic acid metabolism. The United Nations Food and Agriculture Organization and the World Health Organization together established the Joint FAO/WHO Expert Committee on Food Additives (JECFA), which suggested a limit of 0–25 mg/kg for potassium sorbate.

With a chemical formula of $C_6H_7KO_2$ and an IUPAC-ID name of potassium (2,4-hexa-2,4-dienoate) (Figure 1.5), potassium sorbate is made from potassium salt of 2,4-hexadienoicacid sorbic acid, which is known by the name E-202 in the food sector. These are crystalline, white, and odorless. They have a molecular mass of 150.22 g/mol, granule or powder form, and a melting point of 270 °C (518 °F; 543 °K) (Dehghan, et al., 2018). Reactive carboxyl groups and conjugated double bonds in the sorbate structure may have a significant impact on the product's antibacterial activity, quality, and safety (EFSA,2019). Due to its high solubility, stability, and ease of usage, this preservative is most frequently utilized in the food business.

The antimicrobial properties of potassium sorbate rely on pH and separate sorbic acid. Sorbate has a pKa of 4.7 at pH 4.4, meaning that 70% of this chemical is unionized to stop bacteria from growing. As pH rose, the unionization rate fall.Therefore, it is predominantly active at pH values lower than 7.4. This chemical dissolves readily in water (58.5 g/100 mL at 100 °C), maize oil, and chloroform, but it dissolves very slowly in acetone and ethanol. But it is insoluble in benzene. Additionally, the temperature of the water has a significant impact on the solubility rate; a high concentration of ethanol causes the solubility to drop, while it to increase as the temperature rises. The stability of potassium sorbate is influenced by a number of factors, such as pH, temperature, water activity, food components, different metals, and other additions (Yarramraju *et al.,* 2007).

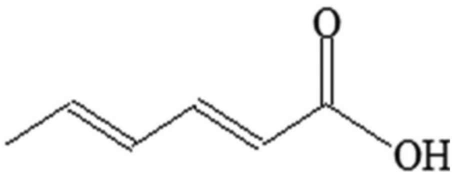
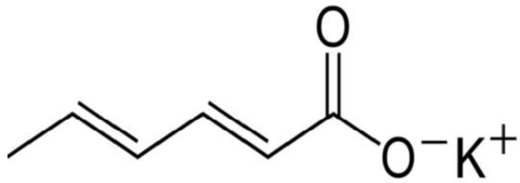
 Sorbic acid structure	 Potassium sorbate structure

Figure 1.5: The chemical structure of sorbic acidand potassium sorbate (EFSA, 2019).

In general, sorbate (sorbic acid) effectively inhibits the majority of moulds, yeasts, and certain bacteria. Sorbic acid is stable in its dry, crystalline state and does not degrade even when kept for an extended period of time at room temperature (Thakur *et al.*,1994). However, during storage, it autoxidizes in foods and solutions, forming carbonyls and other compounds as shown figure (1.6). Its stability is affected by a variety of environmental factors, including pH, temperature, packaging, water activity, atmosphere, microbial load, microbial flora, and food composition. The onset of food browning is linked to sorbic acid degradation. Certain microorganisms are resistant to sorbate, moulds and bacteria and can break down sorbate, which is why they are frequently responsible for food spoiling. To provide the best antimicrobial activity, each circumstance should be evaluated separately, and environmental factors should be managed (Liewen and Marth, 1985).

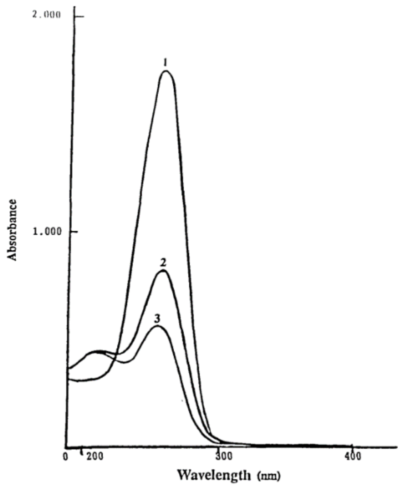


Figure 1.6: Absorption spectra of a 0.2% sorbic acid aqueous solution stored at 37°C changed as follows: 1, fresh; 2, and 3, after 12 and 20 days of storage, respectively. Measured absorbance following a 250-fold dilution (Thakur, *et al.*,1994).

Among its benefits as a food preservative are that it doesn't affect the food's flavor or aroma at any effective concentration dose, prolongs the shelf life of commercial products, works better in acidic pH environments than propionate and benzoate, and inhibits the growth of mould, bacteria, and yeast due to its potent antimicrobial properties (anti-fungal and anti-bacterial) that influence growth rate. Bacteria have a significant impact on the pace of growth such as *Escherichia coli, Staphylococcus aureus, Clostridium sporogenes, Klebsiella* *pneumonia, Pseudomonas aeruginosa, Pseudomonas fluorescens, Pseudomonas cepacia Candida albicans, Saccharomyces cerevisiae, Aspergillus niger* and *Penicillium notatum* but other bacteria have a low effect on growth rate such as Bacillus cereus, Campylobacter jejuni, and Enterobacter aerogenes via a prolongation of the microbial lag phase, while certain microbial strains—such as lactic acid bacteria—are resistant to sorbates or may even digest them under certain conditions (Dehghan *et al.*, 2018).

Even though sorbate is the most widely used legally as a preservative in the food industry, prolonged use or intake over allowed limits may result in negative side effects like allergy, urticaria, asthma, headaches, shortness of breath, chest pain, chromosomal aberrations in human blood lymphocytes, and genotoxic or mutagenic effects in human peripheral blood lymphocytes in vitro. Additionally, sorbate triggers the progressive development of malignancies, aggravates diabetes, and promotes inflammatory pathways (Dehghan *et al.*, 2018).

The Turkish Food Codex EK-2, prohibit the use of potassium sorbate and sodium benzoate in dairy products, yoghurt, and ayran, and regulates the safe use of food additives in Turkey (Küçükçetin & Demir, 2008).

1.3 Standards for Drinking Yoghurt:

Palestinian standard 18-2-2019 defined drinking yogurt as the product manufactured from the fermentation of pasteurized whole or skimmed milk in whole or in part by adding the appropriate lactogenic organisms to which pure water is added with the possibility of adding other milk compounds and salt. It is classified according to the fat content of the final product. The fat content should not be less than 1.5 percent for a full-fat yoghurt, and the fat content should not exceed 0.5 percent for a yoghurt made from skimmed milk. The source of the milk must be specified and clarified, whether it is cows, sheep, goat, buffalo or camels. As for the preservatives, sorbic acid and its salts the presence is allowed. Meanwhile, Potassium sorbate, sorbic acid or any kind of preservatives is forbidden "0.0ppm" of the final product, calculated as sorbic acid. The product is required to be homogeneous without excessive separation in the form of layers and that it does not show signs of damage and deterioration or the presence of particles of dirt and impurities. It must be packed in special package whether glass, UHT carton or plastic, that conform to the mandatory technical instructions No. TI-25. Drinking yogurt is needed to conform to the production label, whether it is the name of the producer, the commercial name, product specification, the components in descending order, the content in units of size (ml, L), the production date and the expiry date, the method of preservation and storage and the nutritional value of the product. In addition, the standard specification requirements stipulate: that the product must be kept at a temperature between 1-4 °C, the pH of the product is between 3.7-4.5 and that the acidity percentage is estimated as lactic acid within 0.6-1.3%, with the exception of salt added to the product, the SNF content of a drinking yogurt cannot be less than 7% from skim milk and 5.5% from whole milk.

Finally, the specific microbial requirements for the product stipulate that the total number of coliform does not exceed 10 cells per ml, the product should be free of *E.coli, salmonella and Staphylococcus aureus.* The total number of yeasts and moulds does not exceed 100 cells per ml and that the product is free of pathogenic microorganisms and their harmful secretions. (PS18-2-2019).

Meanwhile the international standard for fermented milk states **(CODEX standard for fermented milks- CODEX STAN 243-2003) fermented milk** as a milk product obtained by fermentation of milk with microorganisms that result in a reduction in pH, giving a characteristic taste and texture. This includes products like yogurt, kefir, and similar items. The composition of milk for use in fermented dairy products should have milk protein min. 2.7% m/m, milk fat <10% m/m, titratable acidity expressed as %lactic acid min. 0.3% m/m and sum of microorganisms constituting the starter culture min. $10^{\wedge 7}$ cfu/g in total), by the action of suitable microorganisms and resulting in reduction of pH with or without coagulation (iso-electric precipitation). These starter microorganisms shall be viable, active and abundant in the product to the date of minimum durability. In particular, Drinks based on Fermented Milk are composite milk products, obtained by mixing Fermented Milk with potable water with or without the addition of other ingredients such as whey, other non-dairy ingredients, and flavorings. Drinks Based on Fermented Milk contain a minimum of 40% (m/m) fermented milk (CODEX STAN 243-2003). The food additives allowed to be used in a salty or regular milk drink are carbonation agents in case of need for use, stabilizers and thickeners that is restricted to reconstitution and recombination and if permitted by national legislation in the country of sale to the final consumer. As for the preservatives allowed to be used:

a. the presence of sorbic acid and its salts is stated, provided that it does not exceed 1000ppm, calculated as sorbic acid,

b. the presence of benzoic acid, or benzoate 300ppm calculated as benzoic acid and

c. the presence of Nisin 500ppm of the final product.

The Contamination clause stipulates referring to General Standard for Contaminants and Toxins in Foods and Feeds (CODEX STAN 193-1995). Labelling information should be added indicating that it is fermented milk or Drinking yoghurt "like Laban up", mentioning the trade name, clarifying the thermal coefficient to which the product was exposed, and the need to mention the addition of water and the main ingredient in it such as salt, the percentage of fermented milk in the final product (m/m), and the type and quantity of the added starter culture, the milk fat content shall be declared in a manner acceptable in the country of sale to the final consumer, either as (i) a percentage of mass or volume, or (ii) in grams per serving as qualified in the label, provided that the number of servings is stated, labelling of Pre-packaged foods and if necessary, storage instructions, shall be given either on the container or in accompanying documents, except that the name of the product, lot identification, and the name and address of the manufacturer or packer, shall appear on the container. However, lot identification and the name and address of the manufacturer or packager may be replaced by an identification mark. (CODEX stand 243-2003).

1.4 Justification

The dairy industry in Palestine is a vital part of the agricultural sector and a key source of income for local farmers and producers This research will contribute to the development of Palestinian dairy industry and support the local products and allow it to compete with the imported products, leading to the growth and support of the Palestinian economy through the production of a high-quality product that conforms to Palestinian and international specifications and provides healthy and nutritious dairy products that suit the Palestinian taste and provides technical solutions for various dairy factories regarding the effective use of preservatives and thickening agents.

Moreover, drinking yogurt is a perishable product that can harbour harmful microorganisms if not properly processed, handled, or stored. Assessing commercial yogurt quality helps ensure that the product meet microbiological safety standards, thus, protecting consumers from foodborne illnesses. This research will focus on several key aspects:

1. Evaluating the quality of local Palestinian commercial yogurt available in the Palestinian markets

2. Conduct sensory analysis involving trained panellists to evaluate sensorial quality of drinking yoghurt so as to help understand consumer preferences and provide insight into product quality from a sensory perspective.

3. Investigating the effect of season and chemical composition on the storage period and overall quality of available yogurt with a focus on the rheologic and sensory properties.

4. Determining the levels of preservatives present in various local commercial products.

5. Identify discrepancies between labelled and actual values for nutrients, preservatives as this impact's consumer trust and regulatory compliance.

By addressing these focal points, the study will contribute to the development of the Palestinian dairy sector, promoting local production while ensuring safety and quality for consumers.

1.5 Problem Statement

For many years, salty drinking yogurt "*Mukheed* yogurt" was a springtime beverage often made with sheep's milk. The availability of yogurt drinks year-round can be attributed to technological advancements and the use of cow's milk in most dairy goods. Understanding the physicochemical, microbiological, and sensory aspects of this product became primordial necessity since it is a traditional product that is cherished by Palestinian customers and is found nearly in most Palestinian homes. In addition, there were limited studies that investigated the Palestinian traditional yogurts and *Mukheed* chemical and physical properties, even though several international researchers have examined specific traditional yogurts, like *Ayran, Doogh…etc.* and studied their evolution from seasonal beverages to commercially available products throughout the year.

The commercial salty yoghurt industry in West Bank/Palestine faces significant challenges related to product quality and safety, which can adversely affect consumer health and market viability. Despite the growing demand for dairy products, particularly yogurt, the quality of commercially available yogurts remains inconsistent. Factors contributing to this issue include variations in production practices, inadequate quality control measures, and a lack of adherence to national food safety standards. It is noted that, there is a notable lack of comprehensive research focusing on the quality assessment of commercial yogurt brands, which limits the understanding of how to improve production methods and consumer satisfaction.

In this study, focuses on commercial salty drinking yogurt sourced from various locations in occupied Palestine with the objective of research concerning its overall quality and shelf life in relation to various dairy brands during various seasons in the same year. The study will evaluate adherence to Good Manufacturing Practices (GMP) and Palestinian technical instructions, as well as international standards. Given Palestine's notable seasonal variations and geographical diversity, the stages of lactation and birth, and environmental factors that vary from location to location in Palestine due to differences in its terrain (plains, mountains, Jordan Valley, and desert). these factors significantly influence cow's health, milk quality, and composition, which in turn affects the physicochemical and microbiological properties of the yogurt.

Moreover, the lack of standardized production recipes and established manufacturing processes for drinking yogurt in terms of production line configurations, particularly heat treatments, this poses a challenge and can lead to inconsistent microbial quality and product yield.

This research aims to address these gaps in knowledge and practice, ultimately contributing to the improvement of drinking yogurt production in Palestine and enhancing its quality and marketability.

1.6 Hypotheses and Research Questions

In Palestinian society, drinking yogurt becoming the most popular fermented dairy product consumed. Traditionally, this product was made with sheep's milk and was available only in limited quantities during the spring. However, due to technological development and the use of cow's milk have enabled the year-round availability of drinking yogurt, allowing it to become a staple food in Palestinian markets. Today, a variety of locally produced and imported drinking yogurt can be found, each offering nutritional benefits and catering to consumer preferences as well as offer a host of health benefits. Different recipes and procedures in the manufacturing of DY in dairy plants led to increase in its consumption as a major dairy product. The lack of knowledge about the various factors, including milk type, added water, salt, stabilizers, starter cultures, and other additives affecting the final quality of the drinking yoghurt has prompted our investigation of this relatively new commodity on the Palestinian market by examining its physiochemical, rheological, microbiological, and sensory properties in West Bank and throughout various seasons of the same year.

The specific questions of this study include:

1. Are the mandatory Palestinian specifications and technical instructions in conformity with international standards?

2. Does the product conform to the required specifications and mandatory technical instructions?

3. Are the industrial product healthy, high quality, and safe for human consumption?

4. Are local product properties confirming with local standards (pH, Acidity, protein, fat, water content …etc.) during the shelf life?

5. Is there stability in the properties and characteristics of the product during the different seasons of the year (winter, spring...etc.)?

6. Does the location of the product's manufacture influence physicochemical, microbial, rheological and sensorial properties?

7. Are the drinking yogurt properties different depending on the inputs and producers?

1.7 Research Objectives

The primary goal of this study is to achieve a high-quality drinking yogurt product with characteristics and properties that align with the specified mandatory technical instructions. In addition, the final aim is to ensure that these attributes resonate with the taste and preferences of Palestinian consumers, acknowledging the traditional roots of this beverage. Therefore, the study is structured around comparing local commercial drinking yogurts with both international and Palestinian standards for drinking yogurt.

This research aims to highlight the role of seasonal variations and specific processing procedures that influence the production of high-quality drinking yoghurt for both dairy plants and regulatory agencies. By understanding these factors, the study will contribute in minimizing product losses and waste while enhancing consumer satisfaction, leading dairy plants to make decisions, strategic investments in the industry to optimize processes and deliver superior products to consumers.

Accordingly, the study is based on the following objectives

1. To compare local commercial drinking yoghurt with international and Palestinian standards for drinking yoghurt.

2. To investigate the microbiological and physicochemical characteristics of salty Palestinian drinking yoghurt and its effect on shelf life.

3. To compare physicochemical, rheological and microbiological properties of salty drinking yogurt in Palestine during different seasons (winter and spring).

4. To evaluate sensorial properties and consumer acceptance of products.

5. To determine the nutritional and health benefits of the products.

1.8 Summary of Experimental Investigations

This research will examine the factors influencing the stability of salty drinking yogurt during shelf-life period at cooling temperature (4-6°C) by various Palestinian dairy plants at different locations in the West Bank (Five companies) at different seasons. By examining the selected quality parameters (physiochemical, rheological, microbiological and sensorial analysis) as indicated in Fig.,1.7:

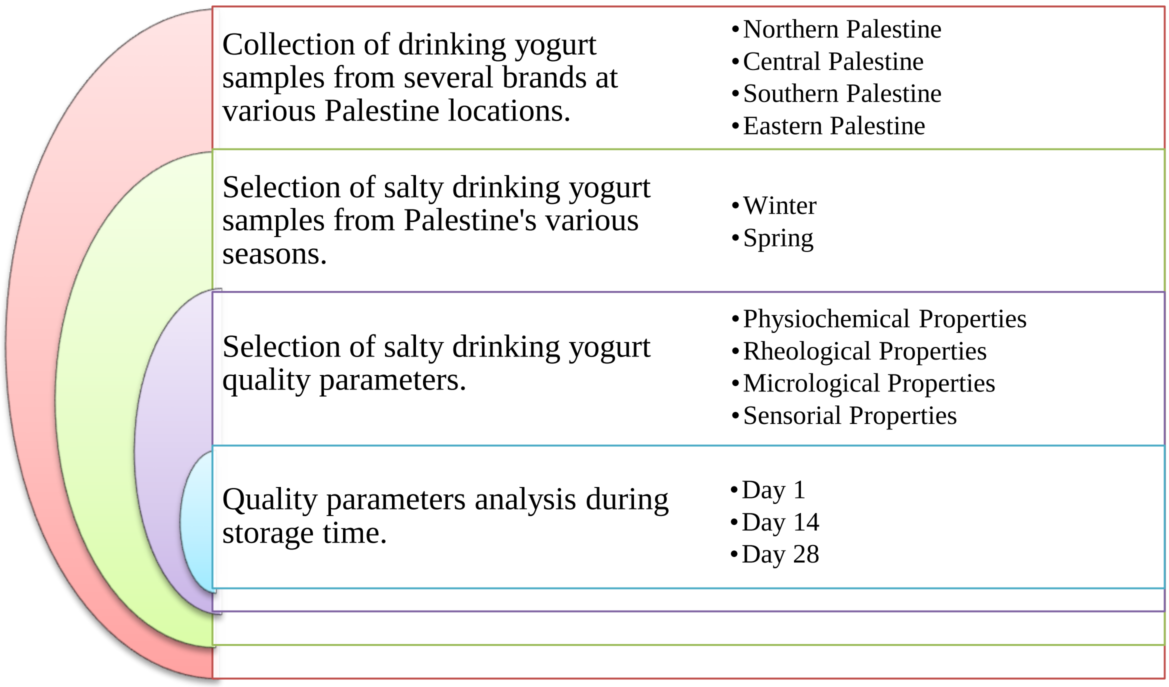


Figure 1.7: Representative chart of the experimental work for the drinking yogurt (DY).

Chapter Two

Literature Review

2.1. Introduction

This chapter will mainly focuses on previous studies on drinking yogurt and other fermented dairy products of similar nature to study the seasonal variations, production, locations and shelf life on quality parameters (physiochemical, rheological, microbiological, and sensory properties) affecting product characteristics, as well as the product compliance with Palestinian and international standards.

2.2. Label Information for DY:

Kang, *et al.* (2019) studied the label information of drinking yogurt the top best-selling commercial brands in Korea by evaluating exhaustive physicochemical properties and detailing the nutrition values and information about the drinking yogurt samples including ingredient list, starter cultures enumeration in each one and nutrition values (Average calories: 84.3, total carbs: 12.25 g, total fat: 2.72 g, protein: 3.25 g, calcium: 98.75mg, sodium: 58.352mg, etc.).

Amirpour, *et al.* (2015) studied the label information of 40 samples of traditional Iranian drinking yogurt (doogh), especially preservatives content such as potassium sorbate, and compared it with the actual content and national standards in Iran (ISIRI:No.2453 2008). Although preservatives were not mentioned on the labels of these products, potassium sorbate was discovered in two commercial doogh-drinking yogurt brands.

2.3. Physiochemical Quality Parameter of DY:

2.3.1 Physiochemical proprieties of DY:

"pH and Acidity"

Akcay, *et al.,* (2020) studied the effect of drinkable yogurt-ayran physicochemical properties through the storage time. The included ayran samples were "control, with sliced peppers and dried powdered peppers" The pH values of control ayran samples (4.32±0.22) in 1^{st} day did not change until the 10^{th} day of storage (4.29±0.03) ($p>0.05$) and then significantly decreased at the 20^{th} storage day ($p<0.05$) to lower pH values (3.70±0.08) as a result of lactic acid accumulation possibly.

In identical sequences, Sobhay, *et al.,* (2019) studied the properties of drinking yogurt fortified with different stabilizers along with storage at 5+-1C for 14 days of storage, samples studied were "control" The pH values of control DY samples (pH: 4.01, TA: 0.47) in 1st day had no significant effect on pH value in final products did not change until the 10th day of storage (pH: 3.99, TA: 0.48) ($p>0.05$) and then significantly decreased at the 20th storage day ($p<0.05$) to lower pH values (pH:3.82, TA: 0.63) as a result of lactic acid accumulation possibly.

In contrast, Erkaya, *et al.*, (2015) studied the effect of thermosonication on physicochemical characteristics of ayran during storage at different temperature and time and found that the titratable acidity and pH level of a fermented product are directly linked with microbial growth and activity which affects ayran quality and the storage stability. The control sample had the highest decrease rate in pH value and the highest titratable acidity value on storage period through 30 days, which had resulted from the high microbial counts. Unlike the rest of the thermosonication-treated ayran samples, didn't change or increase the titratable acidity during the 30^{th} days storage period. There was no significant difference among the pH and titratable acidity values of ayran samples. However, the titratable acidity of the control ayran samples assorted from 0.40 ± 0.02% to 0.45 ± 0.0%, while the pH level assorted from 4.17 ± 0.04 to 4.10 ± 0.02.

Also|, the storage condition (time and temperature) was heavily evaluated by Jakubowska and Karamucki (2019), where pH and titratable acidity effects on the quality of commercial natural yogurt were studied. It was found out regarding the physicochemical tests a significant effect ($P \leq 0.05$) of storage time at both tested temperature ranges (2°C and 8°C), on the active acidity of examined samples. The pH and TA of yoghurts on different days (pH: 4.17, 4.20, 4.10, 4.17), (TA: 37.76,37.60,46.08, 42.92) at 2°C and (pH: 4.17,4.13,4.13,4.16), (TA: 37.76,40.76,46.80, 45.60) at 8°C, respectively. As for the titratable acidity a significant effect of storage time in the yoghurt samples in both cooled conditions at 2°C and at 8°C were observed. The acidity of yogurt was increased during storage as a result of the fermentation activity of microorganisms added to yoghurt and that even under cooled conditions were still able to digest lactose, but more slowly in yoghurts stored at 6 ±1°C compared to 10 ±1°C.

On the other hand, Akbulut and Buzkurt (2020) who evaluated three different pH level in drinking yogurt -ayran samples and studied the impact of pH on the salty taste perception, they found that at higher pH samples a proportionally higher decrease in pH, and after 7 days the difference was mostly insignificant in all samples due to decreasing growth of starter culture and development of acidity. Also, the drinking yogurt greatly affected in terms of other properties such as sensory, texture, viscosity due to the different levels of product readiness depending on pH level.

Effect of seasonal variation characteristics were evaluated by Mahmoudi, *et al.,* (2014) who studied pH and the titratable acidity parameters in 30 yogurt samples produced from sheep milk (15 samples in summer and 15 samples in winter) were collected from January to August 2012 in Iran. The pH and titratable acidity parameters showed changes across the year. Mean pH value were 3.60+0.44 in summer were significantly (P<0.05) lower than that of winter samples 4.42+0.4. Also, the mean titratable acidity values were 1.43+0.20 in summer were significantly (P<0.05) higher than those of winter samples 1.18+0.09.

Ozrenk and Inci (2008) discovered that seasonal changes had an impact on the physical properties of 160 cow milk samples collected between January and August 200 liter were gathered at twelve different locations in the Van province of Turkey. Cows were fed fresh grass in the summer and hay in the winter. Based on data from numerous local sites and seasonal fluctuations, the winter titratable acidity of (0.26±0.053) is significantly greater than those in summer (0.21±0.080). Seasons and locales did not significantly alter pH levels (6.50±0.205 in winter and 6.50±0.472 in summer).

Ramadani *et al.,* (2024) who studied how the physical characteristics of raw milk differed based on the season and the farm location. 252 milk samples in all were examined from seven dairy farms spread across various parts of Kosovo. Over a year, from December 2021 to November 2022, active acidity (pH) was measured. pH demonstrated no significant differences; the average pH of 6.83, ranged from 6.74 ± 0.07 to 6.98 ± 0.07, which is marginally higher than the Kosovo milk quality standards. Regarding the seasons, fresh whole cow milk's active acidity (pH) value typically falls between 6.5 and 6.8, which is a fairly small range and are non-significant seasonal variations; the spring had the lowest pH value (7.05 ± 0.26); the winter had the highest value (7.47 ± 0.25). A higher pH value suggests that the cow has mastitis. To guarantee wholesome and superior milk, the farm and dairy cows' hygiene management should be essential and ongoing.

Ibrahim *et al*., (2019) looked at how temperature and culture concentration influence the physiochemical properties of fermented cow and goat milk. To make yogurt, *Streptococcus thermophilus* and *Lactobacillus acidophilus* cultures were combined and fermented at 40, 43, and 46°C (1:1). The fermentation period lasted 8 hours, and the culture inoculation rate was 5, 10, or 15%. Incubation temperature and culture concentration significantly reduce pH, with values ranging from 4.4 to 5.80 (P<0.05). However, there were no significant variation in TA on culture concentration, while, incubation temperature had a significant effect on increasing TA across samples, ranging from 0.23 to 0.38.

According to Deshwal *et al.,* (2021) confirmed that there were factors that influence post-acidification, the most important of which are starter cultures, which play a significant role in this in terms of biological composition, strains, the type of starters used and their ratios, which may include a combination of different types, different added doses and the bio products produced by the fermentation and post-acidification processes. The components of milk, as well as its quantity and source, all contribute significantly to pH decrease, particularly after acidification. The addition of skim milk bases (SMP), milk protein concentrate (MPC), and casein hydrolysate (CH) contributes to significant fermentation time differences when compared to pure milk. Also, certain added stabilizers and preservatives could affect the reactions within the product during its shelf life. In addition, the manufacturing method, such as homogenization, pasteurization, fermentation time and temperature and other processes, plays a significant role in the decrease in pH post acidification.

2.3.2 Chemical Compositions of DY

"Moisture, TS%, SNF%, Fat% Protein%, Ash and Minerals, and Salt Content"

Ramadani *et al.*, (2024) examined how the location of seven dairy farms spread across various Kosovo regions affected the raw milk's chemical makeup. According to the Kosovo milk quality regulations, the study found that the average composition of the 252 milk samples that were analyzed was good: TS (13.71%), MF (5.12%), SNF (8.60%), and MP (3.25%). Significant differences ($P < 0.01$) were found in TS (12.66±0.14 -15.11±0.23), MF (3.99±0.07 - 7.31±0.72), SNF (8.10±0.21 - 8.74±0.09), and MP (2.99±0.10 - 3.72±0.10) depending on the farm location. Possible causes of regional variations include variations in farming methods or farm breed structure, feeding systems (conventional and organic), milking systems (automatic or traditional), and milking parlours.

Additionally, in the same study, Ramadani *et al.*, (2024) investigated how the chemical composition of raw milk varied based on seasonal fluctuations between December 2021 and November 2022, a duration of one year. In the summer, lower values of TS and MF were found. TS (13.55±0.32), MF (4.88±0.33), SNF (8.63±0.13), and MP (3.24±0.13). However, in winter, it were TS (13.73±0.29), MF (5.35±0.52), SNF (8.67±0.13), and MP (3.32±0.08),r. All of the season-related differences in the examined parameters were statistically not significant and the milk's average composition was good and that it complied with Kosovo's milk quality standards. The reason for these results is that the animals were kept indoors on all farms and fed essentially the same pre-made dry feed; free pasture feed was not utilized in all seasons. This slightly difference can be attributed to variations in nutrient intake (available feed types) or particular climatic factors, such as ambient temperature, environmental conditions, etc., between the cities in the same country.

Kabil *et al*., (2015) conducted experiments on a total of 100 randomly selected samples of raw cow's milk from various farms and shops during different seasons (winter, spring, summer, and autumn) in order to examine the impact of seasonal changes on the chemical composition of raw cow's milk throughout the year in Menoufia Governorate in Egypt. The average values of fat, total solids, protein, and moisture in cow's milk during the winter were 3.6 ± 0.055, 12.4 ± 0.071, 3.5 ± 0.046, and 85.5 ± 0.075, respectively. In summer, the average values were 3.1 ± 0.058, 11.1 ± 0.092, 3.1 ± 0.060, and 88.8 ± 0.092, indicating that seasonal variations have a large impact on the chemical composition of milk and its products.

In accordance with Ozrenk and Inci (2008), the composition of 160 cow milk samples from January to August 2001 showed the impact of seasonal change. The samples were fed by hay during the winter and green grass during the summer months. These came from 12 different local locations in Turkey's Van province. The winter fat content of 3.1±0.683 and the summer 2.3±0.938 have been shown to be significantly distinct based on the results of several local points. The seasonal fluctuation effect was found to have a significant impact on the protein content rate (2.868±0.814 in winter and 2.794±0.944 in summer), TS (11.5064±1.023 in winter and 10.8683±1.841 in summer), and fat (3.1±0.683 and 2.3±0.938), respectively. But, the minerals (0.802±0.106 in winter and 0.8641±0.160 in summer), and SNF (8.4064±0.989 in winter and 8.5683±1.701 in summer) were not significant in the seasonal and location variations.

The physiochemical characteristics of fermented cow and goat milk yogurt were examined by Ibrahim *et al.*, (2019) in relation to temperature of incubation and culture concentration. *Lactobacillus acidophilus* and *Streptococcus thermophilus* cultures were mixed and fermented at 40, 43, and 46°C (1:1) to produce yogurt. The culture inoculation rate was 5, 10, or 15% during the 8-hour fermentation phase. The increased incubation temperature considerably decreased Total solid (TS). Nonetheless, culture concentration had a significant impact on TS in yogurt and had a noticeable raised TS across samples, ranging from 12.59 to 14.28 as well ($P<0.05$).

Beşir & Mortaş (2022) analyzed proximate Ayran's chemical characteristics are derived from varying amounts of cow and hemp seed milk combinations. Ayran samples had total solid levels ranging from 7.15 to 9.61%, with the control sample having the highest concentration (9.61 g/100 g). In accordance with the Turkish Food Codex on fermented milk products, the semi-skimmed ayran group (0.8%–1.2% milk fat) had a fat level of 1.34+0.0% and the protein content in control was (1.34+0.02%). As for the Ash content was (1.18+0.01%).

However, Kang, *et al.*, (2019) studied inclusive evaluation of physicochemical properties of commercial drinking yogurts in Korea and conducted tests on the top six best-selling brands purchased from a local supermarkets within 1 week after production and within 2 days after purchase, and tested them for soluble solids content and minerals composition. The contents decreased in the following trend K > Ca > P > Na. In six yogurt samples were plentiful in each of macro-minerals were ranged between 123.01-157.23 mg/100g of potassium, 121.42-148.39 mg/100g of calcium, 84.45 -112.28 mg/100g of phosphate and 34.34-46.74 mg/100g of sodium in samples.

2.3.3 Dose and Concentration of Preservative in DY: potassium sorbate

Kucukcetin *et al.*, (2007) studied the potassium sorbate concentration and other preservative in ayran and other commercial dairy products in Antalya, Turkey. Fifteen samples of ayran from total of 90 samples of dairy products were analyzed. Potassium sorbate was not detected in any ayran samples, which were acceptable according Turkish Food Codex.

Mazdeh *et al.*, (2014) studied the presence of potassium sorbate and Sodium benzoate preservative in doogh (Iranian drinking yogurt) by high-performance liquid chromatography with UV detection (HPLC–UV) where their presence was considered prohibited according to national standards in Iran. This study was carried out on 130 samples of doogh from 13 different brands. Potassium sorbate was found in only 13% of them. The means of sorbate in the samples were 13.3 ± 39.6 mg kg^{-1}.

Amirpour *et al.*, (2015) determined the level of potassium sorbate and Sodium benzoate preservative in 400 food samples including Iranian doogh by high-performance liquid chromatography where their presence was not allowed in dairy product in general. This study was done using 40 samples of doogh from 4 different brands. Potassium sorbate was detected in two brands of doogh samples where the mean of sorbate concentration in the samples were 32-83 mg kg−1.

2.4 Rheological Quality Parameters of DY:

2.4.1 Viscosity:

Erkaya, *et al.* (2015) studied the effect of heat treatment on physicochemical characteristics of ayran during storage at different temperature and time using thermosonication technique they found that the samples of ayran had non-Newtonian behavior, where ayran was considered a pseudoplastic fluid, and the heat-treated samples consistency's coefficients were significantly lower than that of the thermosonicated samples. Specifically, the consistency coefficient was negatively affected by the heat treatment and the highest decrease rate on storage period through 30days. However, the viscosity of the control ayran samples assorted from 45cp to 55cp, while the 90°C/1min heat treated assorted from 17cp to 15cp.

Pakbin *et al*., (2015) evaluated the rheological characteristics of Doogh, an Iranian yogurt beverage, and investigated ways to increase the viscosity of Doogh fermented by *Leuconostoc mesenteroides* under optimal conditions for the production of exopolysaccharides (EPS), such as a temperature of 25°C and varying sucrose contents. The addition of sugar had no appreciable impact on the viscosities characteristics before fermentation. The Doogh samples' viscosity increased according to their sugar content during the fermentation process, reaching 10.01 cp. When compared to other stabilizing methods, Doogh's economic objectives were reasonable and its viscosity as an edible solution was enhanced.

Beşir & Mortaş (2022) reported the characteristics of drinking yogurt - Ayran is made with varying amounts of hemp seed milk combinations and cow milk in varied ratios. Because the consistency coefficient of the control ayran, which was 100% cow's milk, was the highest, the ayran samples exhibited non-Newtonian behavior and were considered a pseudoplastic fluid. The viscosity of the control ayran samples varied average 278+2.83mPa.s.

Akbulut &Bozkurt, (2020) evaluated the effect of pH on the viscosity of ayran using Brookfield viscometer model RVDV-II+, UK and was conducted throughout the storage period on the 1st ,10th and 20th day. It was found out that the viscosity rates increased with increasing pH, at pH 4.6 samples were the highest throughout the storage period and ranged 250 cP.

The effects of incubation temperature and culture concentration on the physiochemical characteristics of fermented goat and cow milk were examined by Ibrahim *et al.* (2019). *Lactobacillus acidophilus* and *Streptococcus thermophilus* cultures were mixed and fermented at 40, 43, and 46°C (1:1) to create yogurt. The culture inoculation rate was 5, 10, or 15% during the 8-hour fermentation phase. Increased viscosity values were considerably ($P<0.05$) influenced by the incubation temperature. However, the increased viscosity values of yogurt samples, ranged from 67.26 to 99.3 cp, were not significantly impacted by the culture concentration.

Li, *et al.* (2021) studied the effect of seasonal variation (Early season: August to October, mid-season: November to February, and late season: March to May in many of year) on the quality of 3 types of yogurts' viscosity from 4 to 6 batches of yogurt. The initial viscosity of stirred yogurt was significantly affected by season early-season yogurts had significantly higher than mid- and late season yogurts, and the resistance of the viscosity to shear-induced thinning, was higher in the late-season than in the early and mid-seasons. Conversely, the viscosities of the set yogurt by stirring did not completely follow the stirred yogurts in the same seasonal firmness's trends. The stirred yogurt viscosity was affected by other properties than firmness of the yogurt before stirring, which varied with the season. The late-season yogurts had higher viscosity compared to their lower initial firmness and this might be related to the more liquid properties of the yogurt gels and the WHC was higher relative to mid-season yogurts.

2.4.2 Serum Separation and WHC %:

Koksoy and Kilic, (2004) assessed the rheological and sensory characteristics, the serum separation applications of hydrocolloids in textural stabilization, and the absence of serum separation of Ayran after 15 days of storage at 4 °C. Different stabilizers were applied in varying concentrations. Guar gum inhibited serum separation in ayran and had the highest apparent viscosity and consistency index. At a higher dose of 0.50%, HMP and gelatine were beneficial in preventing serum separation in ayran, but not at a level of 0.25%.

Erkaya, *et al.* (2015) studied the effect of thermosonication on physicochemical characteristics of ayran during shelf life and showed that the ayran's samples had serum separated especially in control samples and 90°C/1min heat treated samples. While stored ayran samples had sedimentation of large particles and casein proteins at the bottom due to aggregation causing separation of the serum. The serum separation of the control ayran samples increased from 16.0+4.2% to 35.5+2.1%, while the highest increase in the 90°C/1min heat treated varied from 33.5+3.5% to 42.0+2.8% during 4 weeks.

Beşir & Mortaş, (2022) studied syneresis and serum separation on the features of ayran (yogurt drink) prepared from varying quantities of bovine and hemp seed milk mixtures at varying concentrations during the 14th day. The serum separation was determined by gravitational force during storage time and syneresis was carried out by centrifugation method. At the end of the storage period, the control samples were with the lowest serum separation rate (13.64%), while the syneresis of control samples showed no significant changes ($P>0.841$) and the syneresis rate in control samples were the lowest value for both analyses.

Akbulut &Bozkurt, (2020) investigated the effect of pH on the serum separation level in drinking yogurt -ayran samples by tracking samples in graduated cylinder at 4°C over a period of 28 days. It was observed that the end fermentation of samples at pH 4.2 remained stable during at 3ed day, and the samples were the least separated, while samples with pH 4.6 were the highest throughout the storage period.

Pakbin *et al.*, (2015) examined the rheological properties of Doogh, an Iranian yogurt beverage fermented by *Leuconostoc mesenteroides*, under ideal conditions for exopolysaccharide (EPS) synthesis, which included a temperature of 25°C and sucrose concentrations ranging from 0% to 2%, w/w. Sugar addition showed no noticeable effect on the rheological parameters of Doogh samples prior to fermentation. The serum separation analysis results showed that the serum separation values of the samples were more stable during fermentation. The stability of the suspension improved as the volume of serum separation decreased.

Li, et al. (2021) studied the effect of three seasons (August to October, November to February, and March to May in a year) on the quality of 3 species of yogurt (set yogurt, stirred yogurt, and Greek-style yogurt) from 4 to 6 batches of yogurt. Set yogurts and greek-style yogurt in mid-season had the highest levels of spontaneous syneresis and the lowest WHC in both years, although the variation in spontaneous syneresis was not statistically significant (P = 0.059). In contrast, stirred yogurts' WHC was not affected by seasons or years variation.

2.4.3 Density:

Density depends on a number of variables, including temperature, processing conditions (agitation and homogenization), milk fat and solids content (higher fat content in milk indicates lower density and vice versa). Milk has a seasonal variation in density throughout the year, ranging from 1.025 to 1.035 g/cm3, with higher densities in the summer and lower densities in the winter (Sodini *et al.,* 2004).

Parmar *et al*. 2020 investigated the impact of seasonal variations in composition on milk density by testing a total of 1035 samples of raw whole milk from various seasons and genetically diverse cows. The results showed that the summer season had the highest density value (1.0314± 0.00005 g/cm3), while the spring season had the lowest density value (1.0304 ± 0.00008 g/cm3). Density values varied significantly (0.001 g/cm^3) throughout the seasons. A significant effect was observed on the variation in milk's density for all the parameters, including the animal's genetic group, parity, feeding treatment, season, instrument, days in milk, and days in milk squared, as well as the milk constituents fat, lactose, and protein.

The impact of seasonal variations and farm location on milk density is studied by Ramadhani *et al.* (2024). Seven dairy farms from various Kosovo geographic regions were examined over the course of a year, from December 2021 to November 2022. The study found that, out of 252 milk samples that were analyzed, the average density complied with the Kosovo milk quality regulation, which is D (1.028 g cm-3). There were statistically significant variations at the P< 0.01 level, with the overall value ranging from 1.024 to 1.031 g/cm^3. Variations in the total solids content may be the cause of the variations in density values. The summer had the lowest value (1.028 g cm-3), and the winter had the highest value (1.029 g/cm^3). However, results variation were not statistically significant.

Kiani, (2008) studied the density and other rheological properties of doogh (Iranian drinking yogurt) in three randomly samples from locally industrial products by hydrometer where the means of samples were significantly different and were approximately in the range of 1.021 to 1.06 g.cm^{-3}.

2.5 Microbiological Quality parameter of DY

2.5.1 Microbial quality: Pathogen and spoilage microorganisms

Hamad (2012) stated in his report that food's characteristics are changed to varying degrees by the metabolic activity of bacteria that thrive in it. While some of these changes—like those take place during fermentation—are beneficial, others—like those lead to food poisoning and spoiling—are undesirable. The following sections provide a summary of the major factors influencing microbial proliferation in foods: Nutrient content, water activity, pH value, redox potential, the presence of antibacterial compounds, and mechanical barriers to microbial invasion are examples of intrinsic food characteristics; extrinsic factors related to the food's storage environment include storage temperature, gas composition, and relative humidity in the surrounding atmosphere; Implicit factors pertaining to the microorganisms themselves include interactions between the food-contaminating microorganisms and the food, such as their capacity to use various nutrient sources, withstand stress, and generate substances that either promote or inhibit the growth of other microorganisms, etc.; Processing factors, such as heating, cooling, and drying, alter the food's composition and the kinds and quantities of microorganisms that remain in it after treatment; The interactions between the aforementioned factors can also have a complex impact on the growth of microorganisms in foods; these effects can be additive or synergistic.

Arakçi and Küçüköner, (2003) investigated 5 different flavored yogurt samples for : the total aerobic bacterial count, coliform count, and yeast and mold counts in yoghurt samples at 1, 6 and 10 days interval. All of the samples had <0.01 log CFU/ mL coliform bacteria throughout the validity period and conformed to the Turkish Standards Institute (TS 1330) where a maximum count of 1log cfu/ml of coliform was allowed in yogurt. The yeast and mold count in all the yogurt samples increased progressively during storage at 5°C. The count of yeast and mold in yoghurt samples ranged from 0.32-0.46 log CFU/ mL. Likewise the aerobic mesophilic counts in yoghurt samples increased progressively during storage. These results were ranged from 5.47 to 5.70 log CFU/ mL during storage. The total bacterial count was higher in one of the yoghurt samples.

Moreover, Matin, *et al.* (2018) analyzed 50 yoghurt samples from ten randomly chosen areas in Bangladesh were examined for microbiological quality, and their total viable bacterial and total coliform counts were determined. A range of from 7.2 to 8.7 log CFU/ mL and 2.0 to 2.6 log CFU/ mL, respectively, were the results. Yogurt samples had a total yeast and mold count ranging from 2.3 to 3.9 log CFU/ mL. This study suggests that processing plants should prioritize quality control. The levels of mold, coliform, yeast, and bacteria suggested that the product's manufacturing and packaging could result in excessive contamination.

Another results emphasis on the study of shelf life of ayran–shalgam mixtures carried by Uzay, *et al.* (2020). The influence of microbiological parameters of ayran–shalgam mixture were studied using three types of mixtures in different percentage from ayran -shalgam and were stored at refrigerator at 4 C in glass bottles for 28 days and analyses were performed at 0th, 7th, 14th, 21st, and 28th days of storage. The results showed that, total aerobic bacteria count of the mixtures increased with respect to time and the highest count (6.2 log CFU/ mL) was observed for one of the samples from mixture at the end of the storage period. The counts of yeast and molds were increased with respect to time and similar counts (5.5–6.0 log CFU/mL) were observed for all mixtures at the end of the storage period. *Lactobacilli* count was decreased in first two weeks for two samples from mixtures there after it increased. However, this increase was at most 0.4 log CFU/ mL . It was noted that the number of *Lactobacilli* increased while the *Streptococci* count decreased. As for the last group of samples mixture, the decrease in *Lactobacilli* count was up to three weeks and then about 0.7 log CFU/ mL increase was observed. It is presumed that the death of *Streptococcus* during the storage because of their relative sensitivity to acidic conditions throughout the cold storage is the reason for this decrease.

Some studies have shown the effect of coliform bacterial family's growth characteristics in the products during its shelf life. Jakubowska and Karamucki (2019) studied the effect of storage time and temperature on microbiological quality of natural yoghurt stored in refrigerator at 2°C and 8°C for 3 weeks. They found that the level of *Lactobacillus* decrease over the entire storage period from 5.97 log CFU/mL in first day to 2.66 log CFU/mL at 2°C and 2.10 log CFU/mL at 8°C for 21st day. As for the bacteria from the *Enterobacteriaceae* family or yeast and mold were noted no infections that's mean the hygienic quality of the checked yogurts samples were good.

Moh, *et al*. (2017) examined the impact of seasonal microbiological conditions on three commercial brands and locally produced yogurt (Shalom) sold in three regions of Cameroon over the rainy and dry seasons. Ninety-six samples were gathered, and the microbiological assays included counts of yeast, mold, total aerobic bacteria, and total aerobic bacteria coliform. When compared to other data, the total aerobic bacterial counts of all the samples (8.8-11.78 log CFU/mL) during Cameroon's dry season were extremely high. During the wet season, there were significant differences ($P \leq 0.05$) between them and the commercial brands. As for the total aerobic bacteria coliform count during the rainy season were higher than the dry season meanwhile both of seasons were extremely high relative to the typical levels of total count, Coliform species and other *Enterobacteriaceae* were compared to the rainy season, during the dry season, the quantity of isolates was greater. It is a sign of inadequate processing, bad hygiene, post-processing contamination, or contaminated water source and tools as defined and were advised by public health organizations around the world and are employed as indicator organisms for the microbiological quality of milk products. However, the absence of coliforms in some samples is a sign that the supply chain is following Good Manufacturing Practices (GMP) in compliance with the National Agency of Food and Drug Administration Control (NAFDAC) standard, which states that E. coli and coliforms should not normally be found in any 100 ml sample of yogurt. Additionally, the number of mold and yeast was lower during the winter season and higher during the dry season. In most cases, the yeast count was higher than the international standard, suggesting that yeast can grow more in warmer climates and increase species diversity and microbial flora, which can lead to higher levels of contamination. However, during the rainy season (winter), the samples were still free of mold, with a decrease in the number and spread of molds in all samples, to be noted that maximum of 0.3 log CFU/mL of mold is allowed in yoghurt. The researchers pointed to warm temperatures, illiteracy, and unhygienic production methods, poor refrigeration and the length of time the product remains in the market as the main reasons for the high levels of pollution and unsafe yogurt.

2.5.2 Micro-biota: Lactic Acid Starter Culture

Akbulut &Bozkurt, (2020) studied the effect of pH on the starter cultures log phases growth of by B12 agar and MRS ager for counting of *Streptococcus thermophilus* and *Lactobacillus* *bulgaricus* during 20 days. At pH 4.2 and 4.4 samples, *S. thermophilus* counts appeared higher than at pH 4.6, and the growths phase did not deteriorate throughout the shelf life, but *L. bulgaricus* counts decreased by approximately 1 log CFU/mL during the 20 days.

Ibrahim et al. (2019) investigated how culture concentration and fermentation temperature affected the growth of LAB in goat and cow milk. The yogurt was made using fermentation temperatures (40, 43, 46°C), a 1:1 ratio of *Lactobacillus acidophilus* and *Streptococcus thermophilus* strains, culture inoculation (5, 10, 15%), and fermentation times (8 hours). LAB growth rates in yogurt samples ranged from 6.7-7.08 log CFU/ml, indicating considerable differences. The ideal fermentation conditions for cow and goat milk were 46°C, 10% culture concentration, and 8 hours.

Moh, *et al.* (2021) studied the microbiological quality in artisanal yoghurt and three commercial brands sold in three Cameroonian areas where the effect of Lactic Acid Bacteria and their antibiotic susceptibility were evaluated during seasonal diversity of the dry and rainy seasons .A total of ninety-six samples were collected, and the microbiological quality was based on the total count of lactic acid bacteria (lactobacilli and cocci). The lactobacillus counts of locally made yoghurts during both seasons were lower than the commercial samples. However, the viable count of lactobacilli within the samples were reduced during the rainy season compared to the dry season while increased in the total coccus count was spotted during the rainy season except samples from one of brands which alternatively decreased. These findings suggest that, the scarcity of suitable lactic acid bacteria (LAB) and the presence of pathogenic Lactic Acid Bacteria due to lack of quality control and ignorance may hamper their health benefits and protection provided to consumers resulting in exposure to a high risk of food-borne infections and poisoning associated with resistant strains.

2.6 Sensory Evaluation of DY :

Beşir & Mortaş, (2022) analyzed sensory characteristics of ayran produced from different ratio of cow and hemp seed milk mixtures at different levels and the best score by top ten point from quality factors like appearance, texture, the flavour, mouth feel and general acceptability in control sample were 8.47+0.91, 7.60+1.45, 8.13+1.30, 7.53+1.35 and 7.60+1.71 , respectively.

Sobhay, *et al*. (2019) studied the drinking yogurt sensorial evaluation score using different types of stabilizers. The quality factors of control samples were estimated for appearance (7.0/10 points), consistency (31/ 40points), flavour (47/ 50 points) and the total of scores were (85/100 points) according to the scheme of (Keating and Randwhite, 1990).

Akbulut & Bozkurt, (2020) investigated while all samples had the same 0.5% salt content, the sensory qualities of ayran were related to three different pH levels on the perceptivity of salty taste for overall like, flavor, and consistency using a 9-point hedonic scale. After seven days, the salty sensory scores had a substantial ($p < 0.05$) impact on the pH readings. Saltiness ratings were greater in pH 4.2 samples than in pH 4.6 samples.

Regarding the sensory qualities of Doogh, an Iranian yogurt beverage fermented by *Leuconostoc mesenteroides*, they were assessed by Pakbin et al., (2015) under ideal conditions for exopolysaccharide (EPS) synthesis, which comprised a temperature of 25 °C and sucrose concentrations ranging from 0% to 2% w/w. Following a 72-hour fermentation period, Doogh samples were evaluated for overall acceptability, taste, and texture. Twenty volunteers participated in the sensory analysis. Scores ranged from Like extremely (7) to Dislike extremely (1) on a 7-point scale. The results of the analysis revealed that while the consistency and acceptability of the fermented Doogh samples differed significantly from the unfermented and fermented samples without added sugar, the taste of all samples (fermented and unfermented) was the same, demonstrating the acceptability of this stabilization method for increasing the viscosity of Doug yogurt drink as an edible solution.

Chapter Three

Materials and Methods

3.1 Introduction

This chapter presents the study required materials and methods used, implementation strategies, and product modifications made at various times of the year, from the beginning of the product's shelf life until its end. This section covers the sources of the materials used in the analysis of the quality parameters of different brands of SDY as well as the experimental design, which includes sampling, physicochemical, rheological, and microbiological analysis during the storage period in various seasons, as well as sensory evaluation of the samples. There will also be statistical analysis on display. Every analytical step was completed in accordance with published papers or the Bacteriological Analytical Manual (BAM).

3.2 Sampling:

Samples collection and preparation: The study was split into two seasons for Palestinian DY:

Our research included five top-selling commercially available natural Palestinian yogurt drink brands, sampled between 2022–2023. These yogurt drinks, made from cow’s milk by various national dairy firms, represent the major brands in the Palestinian market. The samples, labelled as industrial products, were collected from a large retail chains Shaini chains throughout the West Bank-Palestine. The samples covered northern Palestine: Candia Co.; central Palestine: Al-Binar Company; southern Palestine: Al-Junaidi Co. and Al-Jibreni Co.; eastern Palestine: Arab Construction Project Association.

The product's potential variations during the course of its shelf life and over several seasons were examined. In the winter, 210 samples were purchased at the Shaini local supermarket in Ramallah, while 180 samples were purchased at the Shaini Extra local supermarket in

Hebron in the spring. All collected samples are safe for human consumption and have a long shelf life and the production date is within three days to one week.

Table (3.1): The quantity of samples to be evaluated during the product's shelf life in both seasons for five brands

<table>
<tr><th>Brand</th><th>Season</th><th>Quality Parameters</th><th>Storage Time</th></tr>
<tr><td>A</td><td rowspan="5">• Winter
210 samples

• Spring
180 samples</td><td rowspan="5">• Physiochemical Parameter
pH, Acidity, Chemical Composition

• Rheological Parameter
Viscosity, Density, Separation & WHC

• Microbiological Parameter
TPC, Coliform, Fecal, Yeast, Mold & LAB

• Sensorial Properties
In Winter (6samples*5Brands)
Acceptability, Flavour, Texture & Mouth feel</td><td rowspan="5">• Day 0
✓ All Samples
✓ All Tests
✓ In Two Seasons

• Day 14
✓ All Samples
✓ pH, Acidity, Viscosity, TPC, Coliform, Fecal, Yeast &Mold
✓ In Two Seasons

• Day 28
✓ All Samples
✓ pH, Acidity, Viscosity, TPC, Coliform, Fecal, Yeast &Mold
✓ In Two Seasons</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td></tr>
<tr><td>D</td></tr>
<tr><td>E</td></tr>
</table>

In both seasons (winter and spring) yoghurt samples were randomly chosen and were followed by microbiological and physiochemical testing. To maintain freshness, the DY samples were refrigerated at 4–8 °C. Yogurts evaluated shelf life, were thirty days. As part of our trial strategy, we tested the yogurt both right after purchase and every two weeks during storage. Within the first week of purchase, a total of thirty samples from each brand underwent sensorial analysis. Samples were evaluated for compliance with Palestinian and international standards and specifications, and contrasting the outcomes to determine which local product is the best.

This study was carried out in the food processing lab at Hebron University, the private food processing lab in Hebron, and pharmacy and agribusiness labs at Al-Quds University in Abu-Dis.

It could be mentioned that, as soon as the drinking yoghurt sample were opened, and exposed to the environment, microbiological and physiochemical analyses were completed in 90 minutes; ash and mineral analyses were completed in 24 hours after the sample had been dried (using an oven set to 121 °C for two to three hours) and the preservative analyses were completed in 45 minutes as soon as the packaging was opened and exposed to the environment

3.3 Materials and Methods for the DY's Physicochemical Quality Parameters:

All samples analysed by sensory and physicochemical tests:

3.3.1 pH Measurement:

The product's pH has a significant impact on its shelf life, colour changes, and quality characteristics. pH of samples was measured during the studies at both seasons. To measure the pH a digital pH meter (HANNA edge pH, Italy) was used.

3.3.2 Titratable acidity:

The total acidity (natural + developed) or TA is what is referred to as the product's acidity. Using the procedure outlined in the AOAC 947.05 (2005) method, the TA of samples in Soxhlet-Henkel grades was determined (according to recommendations of JAOAC 30.130 and 34.239). TA was calculated as:

$$\% \text{ Lactic Acid} = \frac{Vol.of\ 0.1N\ NaOH\ \ required\ for\ Nutrilization\ \ *90}{Weight\ \ of\ sample*1000} * 100$$

Where, N = normality of titrant; 90 = Equivalent weight for lactic acid; Weight of sample = Volume of sample * Specific Gravity.

3.3.3 Component content %:

About 150 ml of each drinking yogurt sample was set aside for the proximate chemical analysis (moisture and total solid, fat content and solid not fat, protein content, ash content, and salt content).

A. **Total solid and water content:**

Determination of the moisture content from the measured dry matter of the samples. Using a digital moisture analyser from the MAC 110/NH series (Radwag Wagi Elektroniczne, Radom, Poland) was found to be a different method the dry mass content in accordance with (AOAC, 2023). The obtained results were expressed as moisture percentage.

$$\% \text{ Total solids } (Wt/Wt) = \%100 - \% \text{ Moisture content}(Wt/Wt)$$

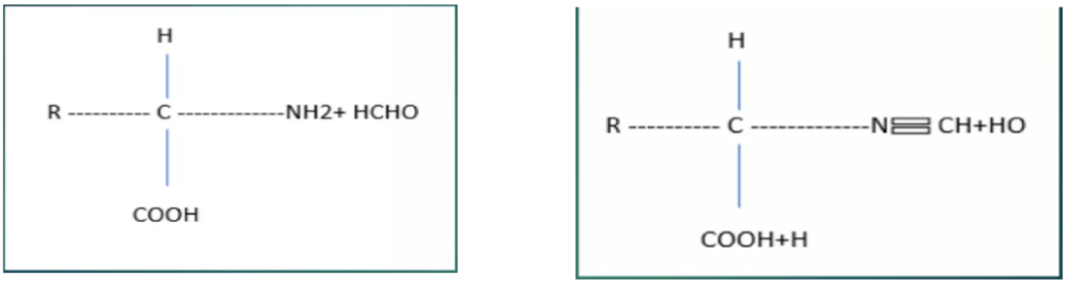
B. **Determination of Fat content:**

The Gerber method (BS 696-2:1989) was used to determine the fat content of milks and milk products according to the method expressed by Klein *et al.* (2001). The procedure reported by the British Standard as described methods by (ISO 19662 / IDF 238:2018) was followed for this determination.

C. **Determination of Protein content:**

Formol titration was used to measure protein content. According to Pyne (1992) modification method of Steinegger's (1905). The Procedures for Analysis of Milk Protein Using Formol Titration followed the process described by Moore et al. (2010). The following formula was used to determine the protein content:

$$Protein\ content\% = \{\langle V2 \rangle \times\ 1.74\}$$



Formaldehyde **Amino Acid + Formaldehyde**

Figure 3.1 The chemical compound structure of formaldehyde and its association with amino acids (Moore et al., 2010).

D. **Determination of ash content:**

Determination of ash content of samples according to the method expressed by Marshall, M. R. (2010). Method provided by the National Renewable Energy Laboratory, Midwest Research Institute, Kansas City, Mo 64110, United States. Ash content was calculated as follows:

$$\text{Ash\%} = \frac{W3 - W1}{W2} * 100\%$$

E. **Level of Minerals: Potassium, Calcium, Magnesium and Sodium:**

Determination of the minerals content of SDY samples using a Milestone Ethos 1 microwave digestion system (Sorisole, Italy) of samples after dissolution or homogenization step and inductively coupled plasma–atomic emission spectrometry was used to determine the elements Ca, K, Na, and P according to the technique stated by Cruijsen *et al.* (2019) based on the official method AOAC 2011.14/ISO 15151:2018/IDF 229:2018. The following minerals were all detectable at the specified absorption wavelengths (nm): calcium (Ca, 317.933 nm), potassium (K, 766.490 nm), and sodium (Na, 589.592 nm). The elements' unit of measurement is mg/100 g of sample.

Nevertheless, the magnesium (Mg) was determined by E.D.T.A titration according to the Jenness' method (1958).

F. **Determination of Salt content:**

The salt percentage was calculated using Mohr's Method according to the approach described by Korkmaz (2001) and the appropriate reagent grade by titrating drinking yogurt samples with silver nitrate $AgNO_3$ normality (usually N/10). Salt content was calculated as:

$$\% \text{ Salt Content} = \frac{Vol.of\ 0.1M\ AgNO3 * \text{Normality of the AgNO3}}{Volume\ of\ sample} * 0.05845 * \text{dilution factor} * 100$$

3.3.4 Food additives: Sorbate concentrate (ppm) analysis:

Determination of the samples' potassium sorbate concentrations in the samples was ascertained by liquid chromatography, utilizing a PDA detector, acetate buffer (pH 4.74) and methanol, in accordance with the methodology described by Esfandiari et al. (2013). It was done in an HPLC (sigma Aldrich, Japan). A C18 column (Hypersil, 100 cm x 3 mm i.d , 3 µm particle size) was used to achieve the chromatographic separation. The wavelength of 255 nm, which is the compound's maximum absorption, was used to detect potassium sorbate.

Preparation of the standard curve ready potassium sorbate (1.340 g; 1 g sorbic acid equivalent). Six points were obtained for each of the potassium sorbate standard curves. Potassium sorbate concentrations were 10, 25, 50, 100, 200, 400, and 500 mg/L. As depicted in Figure (3.2.A).

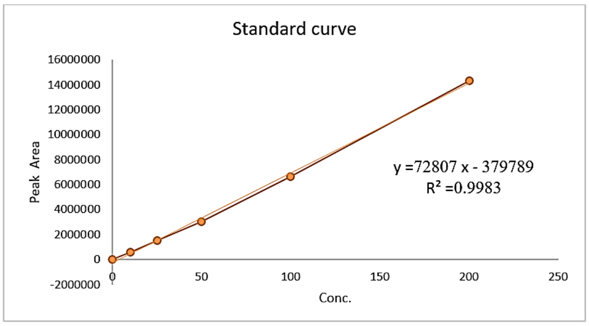


Figure 3.2. A

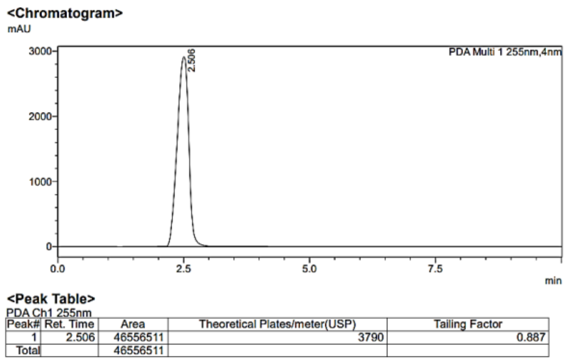


Figure 3.2.B

Figure 3.2. A Standard curve for the analytical properties of the validation method. B. HPLC chromatogram of standard preservative solution (500 ppm) of potassium sorbate.

In order to verify to accuracy and precision of the analytical procedure, the recovery studies were carried out. The recovery of potassium sorbate added to the samples free of the preservative was carried out. SDY samples were analysed before and after addition of 1ml of 500ppm sorbate solution and t the process was repeated six times are shown Figure 3.2.B. The accuracy of the results was calculated through the following equation:

- SP conc. = Standard 500ppm conc. + SD Conc.

3.4 Materials and Methods for the DY's Rheological Quality Parameters:

3.4.1 Viscosity:

Utilization of a digital rotational viscometer (VISCO^{-TM} ATAGO viscosity meter; Japan) to measure each sample's dynamic viscosity. All measurements were done at room temperature (24 ±1 °C) using coaxial cylinder geometry on a small sample adapter with a spindle No. A1 at 250 rpm for 30 seconds and the sample temperature of 18 ±1 °C after calibrated with distilled water at the same temperature of experiment in the viscosity of 1 cp. Viscosity was recorded in cp. Three replications of the test were conducted, as per (Ibarz and Barbosa-Canovas, 2002).

3.4.2 Serum Separation and Water Holding Capacity (WHC):

Each sample's serum separation was measured. SDY samples were put in a 20 ml glass test tube and kept between 6 and 8°C. After being stored for 15 days, the volume of separated serum at the top was measured. Six duplicate samples from each brand were used to measure the serum separation using Koksoy and Kilic.,(2003) method.

WHC measured of samples in first and second seasons of this study were determined as described by Doleyres *et al.,* (2005). Briefly, 10 g of each sample at 5°C was centrifuged at 2555×g for 25 min at room temperature. The resulting supernatant was carefully weighed to determine the amount of excluded water (% wt/wt).

3.4.3 Specific Gravity :

The density of drinking yogurt samples for each brand was determined in triplicate using a lactometer (MilkMan, Coimbatore) with graduated cylinder 250mL and calibrated thermometer to read temperature of the samples first. Density was measured according to FAO method of Milk Processing guide, volume-2 . Density was calculated as:

$$\text{Density} = 1 + \frac{Lactometer\ reading + (Correctedtemperature * 0.2)}{1000}$$

Where, 0.2 is temperature factor, Corrected Temperature = Sample temperature – Standard temperature(20°C)

3.5 Materials and Methods for the DY's Microbiological Quality Parameters:

During each of the two study seasons, six replicates of each type of drinking yogurt were obtained from various manufacturers and producers. These replicates were subjected to microbial tests in order to estimate the growth of total aerobic, yeast and mold, total coliform, and total fecal bacteria. Wherein they were examined on the first day and reexamined every two weeks until the "30-day" expiration date, that is, once every two weeks. Their conformance to Palestinian and international specifications and standards was assessed, and the results were compared between the companies to determine which local product was best. As for the starter culture, bacteria growth for fresh products was only examined on the first day.

3.5.1 Total Plate Count (TPC)

The total bacterial viability of SDY samples was measured based on the pour plate techniques using the Plate count agar (DIFCOTM Manual, 2021). For 48 hours, the cultured plates were kept in an aerobic environment at 37°C. TPC was expressed as colonies forming unit per gram (cfu/ml). (Lin W-H et al., 2006).

3.5.2 Total Coliform Counts (TCC)

Coliform count was measured by using Violet Red Bile agar medium (Difco TM Manual, 2021), which was used for the enumeration of coliforms in SDY samples and appropriate dilutions were pour-plated. Typical pink colonies were counted for the determination of TCC after incubation of plates at 37 °C for 24 hours. (Akcay *et al.,* 2020 ; Sobhay *et al.,* 2019)

3.5.3 Total Fecal Counts (E coli)

Fecal Counts was measured by using Eosin-Methelyne Blue (EMB) agar (HiMedia M317, 2022). After the proper dilutions were poured onto the cultivated plates, they were incubated aerobically for 24 hours at 37°C.

3.5.4 Total Yeast & Mold Count:

Yeast and molds colonies of SDY samples were determined by pour plate technique using Base Rose Bengal Chloramphenicol Agar (HiMedia M640, 2022). Incubation of aerobically at 25∘C for 5 days, the developed colonies were evaluated and counted. Typical biofilms colonies pink zone will be classified yeast and an interconnected network of hyphae (mycelium). (Uzay et al.,2021)

3.5.5 Lactic Acid Bacteria (LAB)

Lactic acid bacteria count of SDY samples was measured based on the double layer pour plate approach using MRS Agar Base (HiMedia M641, 2022). Typical different colonies were counted for the determination of Total Count of culture growth after incubation of plates at 37°C for 3 days.

3.6 Materials and Methods for the DY's Sensorial Quality Parameters:

A consumer sensorial test was conducted with 25 consumers (12 females and 13 males from the student, employee and professors of the Faculty of Agriculture, Hebron University, Hebron between the ages of 18–55 years. Each consumer rated the seven yogurt drinks on a 9-point hedonic scale (1 = dislike extremely to 9 = like extremely) for four liking attributes (overall acceptability, colour, flavour, and mouthfeel). In addition, two background questions were asked: 1) what is your frequency of consumption (less than once a week, or more than once a week) of fermented dairy products like yogurt? 2) What is common name of fermented drinking yogurt? The seven yogurt drink samples were served to the consumer in 60-mL carton coffee cups, water (natural minerals water) and salted sticks crackers (Pretzel) were provided for palate cleansing. Each sample was labelled and presented to the assessors coded and in random order (capital litter code: A, B, C, D and E), and served in a random order to each consumer. A fresh batch of each of the seven yogurt drinks was prepared for the consumer test. The questionnaire is reported in appendix (1).

3.7 Statistical Analysis:

A one-way analysis of variance (ANOVA) was conducted to evaluate differences between samples from different companies at a significance level of $p \leq 0.05$.). Tukey's Honestly Significant Difference (HSD) test was used as a post-hoc method to perform pairwise comparisons of means and identify significant differences across brands, specifically regarding quality parameters in function of days, day 28, and the seasons. Using the Statistical Package for the Social Sciences (SPSS) version 20.0 (SPSS Inc., Chicago, IL, USA), the sample size for each company or season is 6 (n=6). The results of microbiological tests were presented as an average of the logarithm (log10) of colony forming unit (cfu)/ml (log 10 cfu/ml) in the samples as mean ± SD of the replicates.

3.8 Experimental Design

Palestine is distinguished by the diversity of its climatic and geographical regions, despite its limited area. The location of Palestine in the eastern Mediterranean had a significant impact on the diversity of its climate, although it is considered a moderate climate compared to the Middle East region. It belongs to the temperate Mediterranean region and has a Mediterranean climate, a desert climate, and a semi-desert climate. On the other hand, the climate of Palestine varies significantly between the south and north, as well as between the coastal plains and the Jordan Valley. As a result, our research focused on the impact of season and regional variety on the properties of the yogurt drink product.

Spring was chosen as the warm season since it is the season of the traditional drinking yogurt (*Mukheid*) and the most productive season for milk and dairy products overall. A cold season, namely winter, was chosen. The basic quality standards were created using physicochemical, rheological, microbiological, and sensory tests to investigate the product's quality and compare it to Palestinian and international standards.

Table (3.2): Experimental design for the quality parameters of DY product in the study during winter and spring seasons excluding from the sensory analysis, which was limited to the winter.

The Quality Parameters Tests			Day 0	Day 14	Day 28	No. products Samples
Physiochemical Test	pH		X	X	X	5Brands * 6Samples* 3times
	Titrable Acidity		X	X	X	
	Chemical Composition	Moisture	X			1time
		TS	X			
		SNF	X			
		Fat	X			
		Protein	X			
		Ash	X			
		Ca	X			
		Mg	X			
		K	X			
		Na	X			
		Salt	X			
		Sorbate	X			
Rheological test	Viscosity		X	X	X	3times
	Density		X			1time
	Serum separation &WHC		X			
Microbiological test	Microbial Contamination	TPC	X	X	X	5Brands * 6Samples* 3times
		TCC	X	X	X	
		E.coli	X	X	X	
		Yeast	X	X	X	
		Mold	X	X	X	
	Lactic Acid Bacteria		X			1time
Sensorial test			X			5Brands * 6Samples* 1time

X : The day that was used for the analysis   No. : number

Chapter Four

Results and Discussions

4.1 Introduction

In this chapter the findings of the quality parameters analysis of the drinking yogurt samples that were collected for this study over the two seasons (winter and spring) of storage are presented and will be demonstrated by: figures, tables, and parameters, and they of parameters outcomes will be related to one another.

4.2 Label Information of DY

Detailed information about the samples used in this study can be found in Table- 4.1 and 4.2. Comparison of all samples, each according to the production label on the packaging like products name, ingredients, nutrition facts, fat content %, production date and expiry date, E Number of preservative and stabilizers, storing methods of the product and their conformity with the production labelling clause in the PS 18-2-2019.

As can be seen in the table 4.1, all brands of salty drinking milk use fresh pasteurized cow's milk, pasteurized water, salt, and a starter culture. Meanwhile stabilizers used are different depending on the brand: Brand A uses E-406 (agar), Brand B includes gelatin, Brand C and E use pectin and finally Brand D does not specify the type of stabilizer used. The preservatives mainly used is potassium sorbate (E-202) while in Brands C and D preservatives are not listed.

Table (4.1): Information on commercial drinking yogurt samples brands.

Brand	Ingredients and other information
A	Fresh pasteurized cow's milk, pasteurized water, salt, vegetable stabilizer E-406, starter culture, preservative E-202. Keep refrigerated at 4°C Shake well before use Production and expiration dates printed on the Bottle.
B	Fresh pasteurized cow milk, pasteurized water, salt, Gelatin, starter culture, E-202. Keep refrigerated at 4°C Shake well before use Production and expiration dates printed on the Bottle.
C	Pasteurized fresh cow milk, pasteurized water, salt, thickening agent (pectin), starter culture. Keep refrigerated at 2-4C, once opened consumer within 7days, keep product in the same package. Allergy inf.: contains cow milk. Production and expiryy date printed on package or cover.
D	Fresh pasteurized milk, water, salt, starter culture, stabilizer. Keep refrigerated at 3-5C Production and expiration dates printed on the Bottle
E	Fresh and pasteurized cow's milk, pasteurized water, natural stabilizer (Pectin), table salt, starter culture, E-202. Keep refrigerated at 4°C Shake well before use Prod. and exp. printed on package.

The Nutritional Facts Comparison (per 100 ml) were presented as follow in table 4.2. It can be observed that Brand B has the highest energy content at 41.5 Kcal, while Brands C and D have the lowest at 31.5 Kcal. Meanwhile Fat Content: of all brands contain the same amount of fat (1.5 g per 100 ml). Comparing protein content Brand B provides higher protein content (3 g), while Brand A has the least (1.8 g). As for Carbohydrate Content: Brands B and E have the highest carbohydrate content (4 g) and Brands C and D have the lowest carbohydrate content (2 g).

It has been also noted that the calcium content is different depending on the brand, Brand B has the highest calcium content (133 mg), while Brand E has the lowest (116 mg) and Brand D does not specify calcium content. The Sodium content varies widely in the different brands. Brand A contains the highest sodium (210 mg), whereas Brand C has the least (8 mg).

It can be concluded from above tables that Brand B has the highest overall nutritional density, with the most energy, protein, and calcium. While Brand C offers a low-sodium choice, which could be preferable for those watching sodium intake and finally focusing on calcium content, Brands A and B offer higher calcium levels, potentially appealing to those looking to increase calcium intake. Brand D has some missing data on calcium and sodium, which may limit direct comparison in these aspects. The standards (CODEX STAN 243-2003) and (PS 18-2-2019) were found to be met by almost all brands in terms of ingredients, especially the type of stabilizer used. Since Brand D failed to disclose the type of stabilizer used and is regarded as a product that does not meet the specifications, while Brand A, which contains agar, and Brands C and E use pectin, which are allowed for use, while Brand B used gelatine, which is forbidden in both specifications. Brands (A, B and E) have added preservative, which is prohibited in both standards. Fat, were 1.5% in all brands in accordance with PS. However, all of them contained less protein than standards in accordance with CODEX, with the exception of Brand B, which had a higher level (3.0%) compared to other brands. The shelf life and storage method were specified in terms of day, month, and year, indicating the date of production and expiration for 30 days. Brand C was distinguished by the presence of a legal requirement for allergens, which stipulates that the product contains cow's milk. The level of adherence to the nutritional value of fats, protein, and minerals will be confirmed and investigated by studying the actual product ingredients in these samples in Tables 4.3 and 4.4.

Table (4.2): The Nutritional Facts Comparison (per 100 ml) on commercial drinking yogurt brands.

Brand	Energy (Kcal)	Fat (g)	Protein (g)	Carbohydrate (g)	Calcium (mg)	Sodium (mg)
A	33	1.5	1.8	3	130	210
B	41.5	1.5	3	4	133	42.2
C	31.5	1.5	2.5	2	120	8
D	31.5	1.5	2.5	2	-	-
E	40	1.5	2.6	4	116	50

All brands mentioned the product's nutritional value and fully added contents were in accordance with Kang et al. (2019), who examined the label contents of the Korean yogurt drink product for the most significant brands, including the added ingredients and the starter culture, as it is classified as a yogurt drink flavoured with fruits, which differs from the salted drinking yogurt, indicating a significant difference from Korean brands. These results could be justified by adding a percentage of salt, which increases the amount of sodium available in the product (except for Brand D, which did not mention the amount of major minerals on the label). Also, Amirpour, et al. (2015) found that two brands used it, while we found three brands that did, namely (A, B, and E) in winter and (B and E) in spring.

4.3 Physicochemical Quality Parameters of DY:

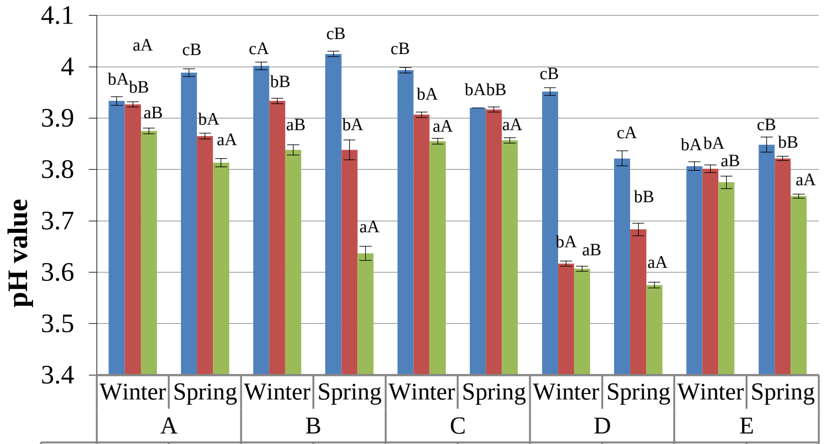
4.3.1 Physicochemical Properties of DY:

4.3.1.1 pH values

i. **Seasonal Influence of pH Values between Companies Samples during Storage time:**

The pH analysis of DY from five companies' samples (A, B, C, D, and E) over three time points (day 0, day 14, and day 28) during winter and spring showed a general trend of pH decline over time, indicative of ongoing fermentation and lactic acid production by lactic acid bacteria (LAB). Winter samples exhibited higher initial pH values across all companies, likely due to reduced microbial activity in colder conditions Fig.4.1 , whereas spring samples showed a more pronounced decrease in pH, suggesting accelerated fermentation in warmer temperatures. These results are in accordance with Mahmoudi, *et al.* (2014) who stated that effect of season on pH and acidity of milk and yogurt from sheep in Qazvin, Iran, Summer samples had a significantly lower mean pH value of 3.60 (P<0.05) compared to winter samples at 4.42.

Samples (B and C) demonstrated the most consistent pH control, reflecting effective regulation of the fermentation process, while company D showed the most significant acidification, particularly in spring. These findings underscore the importance of precise fermentation management to maintain product stability across different seasons.



	Winter A	Spring A	Winter B	Spring B	Winter C	Spring C	Winter D	Spring D	Winter E	Spring E
0	3.9333	3.9883	4.0017	4.025	3.9933	3.92	3.9517	3.8217	3.8067	3.8483
14	3.9267	3.865	3.9333	3.8383	3.9067	3.9167	3.6167	3.6833	3.8017	3.8217
28	3.875	3.8133	3.8383	3.6367	3.855	3.8567	3.6067	3.575	3.775	3.7483

DY samples in Days and Seasons

Fig. (4.1): The results of pH samples according to the test days and seasons for each sample. Seasonal changes within a single day are shown by different capital superscript characters. Variations within the same season are indicated by different lowercase superscript characters.

The results of the DY sample (A) show that, there are significant (P= 0.05) differences in pH between winter days 0 and 28. On days 0 and 14, the mean pH is considerably higher than on day 28. Furthermore, the results show that, there are notable differences in pH between springtime days 0 and 28; the mean pH on day 0 is significantly higher than that on day 14, which is significantly higher than the mean pH on day 28. Overall, the results show a discernible decline over the course of winter and spring days. Additionally, the results show that the winter and spring seasons differ significantly in pH, with the mean winter pH being much lower than the spring pH on day 0, possibly because of the isoelectric point (IEP) at which the product was prepared and the fermentation process was stopped. The results, however, indicate that the mean pH in winter is significantly higher than in spring on days 14 and 28, respectively. The main reason is that season and temperature influence the decrease in pH during the product's shelf life (Jakubowska and Karamucki, 2019), (Mahmoudi *et al*.,2014).

According to the results of the DY sample (B) product in Fig. (4.1) above, there are notable variations in pH throughout the winter months of days 0–14–28. The mean pH on day 0 is significantly higher than that on day 14, which is significantly higher than that on day 28. Additionally, the findings indicate that there are notable variations among the springtime days (0, 14, 28); for example, day 0 is significantly higher than day 14, which is significantly higher than day 28. Thus, the findings indicate that the pH is dropping noticeably every day in the winter and spring. Furthermore, the results of the DY sample (B) product demonstrate that the pH differs significantly between the two seasons (winter and spring) for the day 0, with the mean pH in winter being significantly lower than that in spring, which could be the pH readiness IEP which the products was prepared and fermentation process was stopped in the factory. Additionally, the findings indicate that the winter pH mean is substantially higher than the spring pH mean on days 14 and 28 between winter and spring as a result of possible lactic acid accumulation.

The pH results in the DY sample (C) in Figure 4.1, show a notable variation in pH across days 0, 14, and 28 during the winter months. The mean pH on day 0 is significantly higher than on day 14, which is, in turn, significantly higher than on day 28. Similarly, in the spring, pH levels vary across days 0, 14, and 28, with the mean pH on days 0 and 14 noticeably higher than on day 28. These findings suggest a consistent decrease in pH over time in both winter and spring. Additionally, significant seasonal differences in pH are observed at specific time points. On day 0, the mean pH in winter is significantly higher than in spring, due to the pH readiness IEP. However, on day 14, the mean pH in winter is significantly lower than in spring. By day 28, there is no significant difference in pH between winter and spring, with the mean values being approximately equal. Maintaining the product's stability over the course of its shelf life and the variations in seasons over that time may be a sign of both manufacturing efficiency and product stability.

According to the results for the DY sample (D) in Figure 4.1, there are notable variations in pH across days 0, 14, and 28 during the winter. The mean pH on day 0 is significantly higher than on day 14, which is, in turn, significantly higher than on day 28. Similar patterns were observed in the spring, with the mean pH on day 0 significantly higher than on day 14, and day 14 higher than day 28. These findings indicate a significant, consistent decrease in pH over time during both winter and spring. Moreover, the DY sample (D) results indicate that the pH values of the two seasons (winter and spring) differ significantly. On day 0, the winter mean being significantly higher than the spring mean, due to the pH readiness IEP. Additionally, the results demonstrate that there are notable variations in pH between winter and spring on day 14, with the mean pH in winter being significantly lower than that in spring. The findings also demonstrate that, as of day 28, there are notable variations in pH between the winter and spring seasons, with the winter mean being noticeably higher than the spring mean. The pH measurement fluctuates and declines during the days and between seasons. The cause could be product contamination or an issue with industrial processes, the tightness of package closures, or the manner of preserving and transporting the goods to markets (Alegbeleye et al, 2018).

According to the DY sample (E) results in Fig. (4.1), there are notable variations in pH across days 0, 14, and 28 during the winter season. The mean pH on day 0 is not significantly different from day 14; however, both are significantly higher than the mean pH on day 28. In the spring, there are also significant differences across these days: the mean pH on day 0 is significantly higher than on day 14, which is, in turn, significantly higher than on day 28. These findings indicate a steady decrease in pH over time in both winter and spring, as a result of lactic acid accumulation possibly. Finally, the results of day 0 demonstrate that the pH levels of the two seasons (winter and spring) differ significantly, with the mean pH in winter being significantly lower than that in spring. Similarly, on day 14, the mean pH in winter is significantly lower than in spring. By day 28, the trend shifts. These findings also indicate that there are notable variations in pH between winter and spring on day 28; the average pH in winter is noticeably higher than in spring.

The pH of the sample E on day 0 was found to be the lowest than all DY's samples brand in both seasons, which might be attributed to the pH control point IEP. However, it was noted that the results remained consistent throughout the product's shelf life, which might be attributed to the type of starter cultures and the additives used, the product's stability during the shelf life, or production efficiency (Deshwal *et al*, 2021).

This result is consistent with significant differences in control samples during storage reported by Jakubowska and Karamoucki (2019), and Erkaya *et al.* (2015) in control sample but the thermosonication-treated of ayran sample are not significant during 30 days. Also, Akcay *et al.* (2020), Akbulut and Buzkurt (2020), and Sobhay *et al.* (2019) reported the changes of pH during storage are not significant differences in control samples at the first third of the study and then significantly decrease at 20th day. Also, Ibrahim *et al.* (2008) showed that the fermentation temperature and culture concentration of goat and cow yogurt has a significant effect on decreased pH . While, Ozrink and Inci (2008) demonstrated that the pH values of cow's milk has no significantly decrease in the winter than in the spring, as well as no significant variation between cow farm locations.

ii. **pH influence at day 28 between companies during the seasons:**

A comparison of the different brands on day 28, the final day of the shelf life, reveals significant differences in pH levels across companies (A, B, C, D, and E) during the winter, as shown in Fig. (4.2). Company A has the highest mean pH, which is significantly higher than that of Company C. In turn, Company C’s mean pH is significantly higher than that of Company B, which is significantly higher than Company E’s mean pH. Finally, Company E has a significantly higher mean pH than Company D, which has the lowest pH mean among the companies

The results also show that there are significant differences in pH samples between the companies (A, B, C, D, E) in spring, the mean of pH for company (C) is the highest mean and is significantly higher than the mean of pH for company (A). Company A’s mean pH is significantly higher than that of Company E, which is in turn significantly higher than

Company B's mean pH. Finally, Company B has a significantly higher mean pH than Company D, which had the lowest mean pH among the companies.

The international standard values of pH are in the range (min=3.7, max=4.5), and the results show that all the companies have mean values of pH within the standard range except the company (D) for both winter and spring, and Company B in spring, whose mean pH values fall below the minimum standard value of 3.64, drop pH could be caused by an increase in microbial growth activity, the breakdown of proteins (particularly casein) by enzymes, a rise in the proportion of CO2 that combines with water to generate carbonic acid, …etc (Salaün *et al*, 2005) .

The results also show that there are significant differences in pH between both seasons (winter and spring) for all the studied companies (A, B, D, E), with mean pH values in winter being significantly higher than in spring for each of these companies. In contrast, there is no significant difference (P> 0.05) between the mean pH values of winter and spring for Company C. The consistency in Company C's mean pH across seasons suggests that the product maintains stable quality and pH levels throughout its shelf life, indicating effective control of acidification and overall stability.

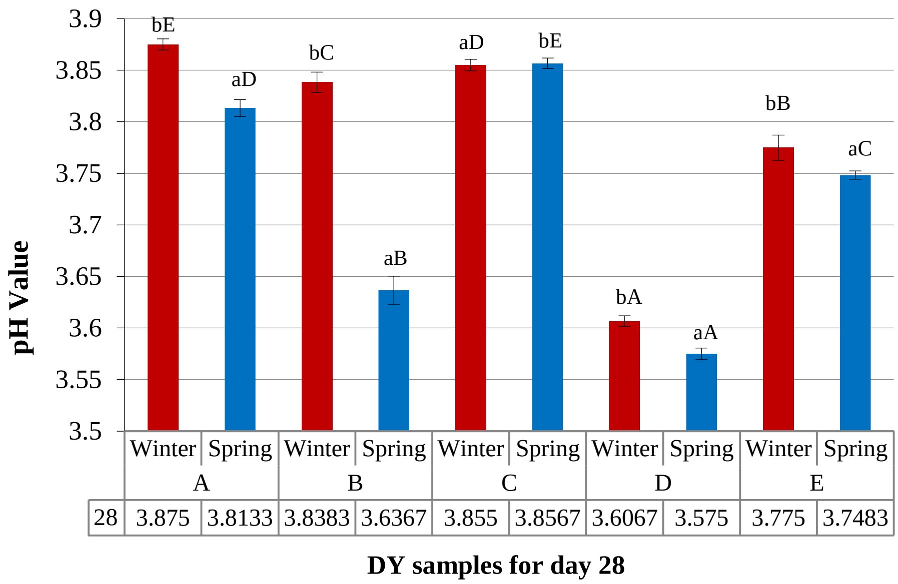


Fig. (4.2): The results of pH values for samples at day 28 in both seasons for each sample. Comparison of differences between companies in a single season are shown by different capital superscript characters. Seasonal changes within a single sample are indicated by different lowercase superscript characters.

This finding was in line with the substantial seasonal variations in raw milk's pH properties, which Ramadani *et al.* (2020) the greatest pH value in the winter and the lowest were recorded in the spring.

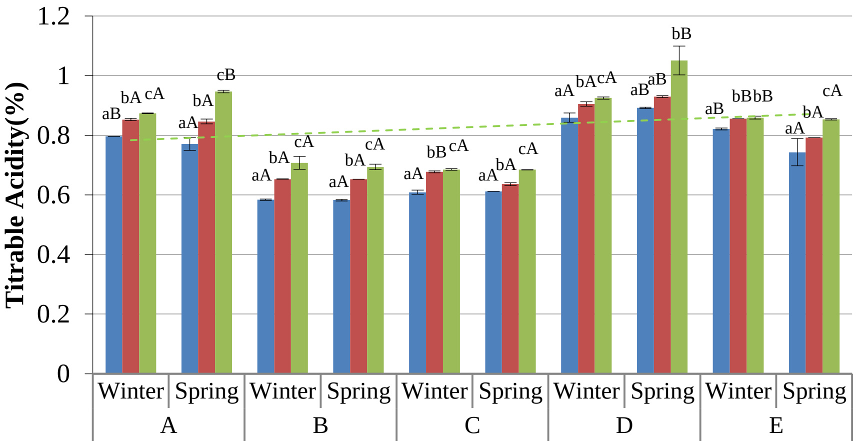
The variations in pH values between the company at day 28 in different season may be caused by temperature differences during storage conditions of samples and seasonal differentiation, microbial contamination, bottles closing, productions' methods and the different ingredients for each company like milk content (%), water content (%), preservatives, stabilizers type, starter culture types and fermentation process in the drinking yogurt which contribute to the changes during storage. These findings were approved by previous studies on an analysis of the quality characteristics of traditional Turkish fermented beverages (Altay *et al*,2013) and (Deshwal *et al*, 2021).

4.3.1.2 Titratable Acidity:

i. **Seasonal influence of the titratable acidity between companies during the shelf life:**

A comparison of the different brands on day 28, the final day of the shelf life, reveals that the acidity analysis of drinkable yogurt from five DY products (A, B, C, D, E) over three time points (day 0, day 14, and day 28) in both winter and spring complements the observed pH trends, indicating a clear inverse relationship between acidity and pH. As expected, acidity levels increased over time, particularly from day 0 to day 28, reflecting ongoing fermentation and lactic acid production. Winter samples generally displayed lower acidity across all samples, consistent with the higher pH observed during this season, likely due to reduced microbial activity at lower temperatures. In contrast, the higher acidity in spring samples is attributed to enhanced fermentation rates under warmer conditions, resulting in lower pH values. This is congruent with the findings of Mahmoudi *et al.* (2014), who found that sheep yogurt samples showed a considerable decrease in pH value in the summer, which was higher than in the winter.

Hamad (2012) confirmed that one of the main factors for microbial growth in food is intrinsic factors such as pH and acidity, as well as extrinsic factors such as storage temperature, gas composition, and relative humidity in the atmosphere surrounding the food; the season plays an important role in determining these factors, as bacteria thrive in a warm, humid environment rich in protein and with a neutral pH or slightly acidic.



	A Winter	A Spring	B Winter	B Spring	C Winter	C Spring	D Winter	D Spring	E Winter	E Spring
0	0.7965	0.771	0.5842	0.5825	0.609	0.612	0.8592	0.8923	0.821	0.7428
14	0.8527	0.846	0.6528	0.6528	0.677	0.636	0.905	0.9293	0.855	0.792
28	0.874	0.9467	0.7073	0.6938	0.6852	0.6843	0.925	1.0515	0.8592	0.8533

DY Samples in Both Seasons

Fig. (4.3): The results of titratable acidity (%) samples according to the test days and seasons for each company. Seasonal changes within a single day are shown by different capital superscript characters. Variations within the same season are indicated by different lowercase superscript characters.

Sample results for the DY sample (A) product in Fig. (4.3) showed significant variations in acidity throughout the winter season (days 0, 14, and 28). The mean acidity on day 0 is significantly lower than that on day 14, which is significantly lower than that on day 28. Additionally, the results indicate that the acidity of the spring days at 0, 14 and 28 days varies significantly; the mean acidity of day 0 is significantly lower than that of day 14, which is significantly lower than that of day 28. Thus, the findings indicate that the acidity is rising dramatically each day in the winter and spring. Additionally, day 0 results indicate that the two seasons (winter and spring) differ significantly, with the mean acidity in winter being significantly higher than that in spring. But on day 14, the results indicate that there are no appreciable differences between winter and spring. Additionally, the results indicate that there are significant differences between winter and spring on day 28, with the mean acidity in winter being significantly lower than that in spring.

Sample (B) results in Fig. (4.3) showed that acidity varies significantly from day 0 to day 14 to day 28 during the winter, with the mean acidity on day 0 being significantly lower than that on day 14, which is significantly lower than that on day 28. Furthermore, the findings indicate that there are significant variations among the springtime days (0, 14, 28). According to the results, sample (B)'s acidity is rising significantly every day in the winter and spring. Furthermore, sample (B)'s results for all days (0, 14, and 28) show that the acidity levels of the two seasons (winter and spring) do not differ significantly, with the mean acidity values for the two seasons (0.584, 0.583), (0.653), and (0.707, 0.694), respectively, being about equal. The beginning cultures themselves, the composition of the milk, temperature and pH, stirring and homogenization, pre- and probiotics, preservative and packing materials could all be contributing factors to the stability of titrable acidity in both seasons (Deshwal *etal*., 2021)

Samples results for the product (C) in Fig. (4.3) demonstrate that there are significant differences in acidity throughout the winter months of 0, 14, and 28. The mean on day 0 is significantly lower than that on day 14, which is significantly lower than the mean on day 28. Additionally, the findings indicate that there are significant differences among the days (0, 14, 28) in the spring. Thus, the mean acidity on day 0 is significantly lower than that on day 14, which is significantly lower than that on day 28. Thus, the findings indicate that the sample (C) acidity is rising significantly every day in the winter and spring. Besides that, the results for days 0 and 28 indicate that there are no appreciable differences between the two seasons (winter and spring), with the mean acidity in winter and spring (0.61) and (0.685, 0.684) respectively being roughly equal. However, there are notable distinctions between winter and spring on day 14, with the winter mean being much higher than the spring mean.

The product of sample (D) in Fig. (4.3) demonstrates that there are significant differences in acidity between days 0–28 during the winter season. The mean acidity on day 0 is significantly lower than that on day 14, which is significantly lower than that on day 28. Additionally, the results indicate that there are significant variations between days 0 and 14 in the spring; on days 0 and 14, they are significantly lower than on day 28. As a result, the findings show that acidity is rising significantly every day in the winter and spring. Furthermore, the results demonstrate that the two seasons (winter and spring) differ significantly, with the days 0, 14, and 28 results in winter being significantly lower than those in spring.

The results for product (E) in Fig. (4.3) show that, during the winter, there are significant differences in acidity between days 0, 14 and 28. The mean acidity on day 0 is significantly lower than that on days 14 and 28. Additionally, the findings indicate that there are significant differences between the days (0, 14, 28) in the spring, with the mean of acidity on day 0 being significantly lower than that on day 14, which is also lower than that on day 28. Thus, these findings demonstrate that the sample (E)'s acidity increases significantly every day in the winter and spring. Additionally, there are significant differences in acidity between the two seasons (winter and spring) based on the day 0 results; the acidity in winter is significantly higher than in spring. is significantly higher on day 14 in the winter than it is in the spring. Likewise, on day 28, the winter mean acidity is significantly higher than the spring mean.

Notably, Product (D) exhibited the most significant rise in acidity, particularly in spring, aligning with the sharp pH drop previously noted, which highlight the importance of controlling fermentation processes to maintain product quality. These results indicate the direct correlation between pH reduction and increased acidity, driven by microbial fermentation in varying seasonal conditions.

These results are consistent with previous studies, such as those reported by Erkaya *et al*. (2015), Jakubowska and Karamoucki (2019), as well as little variations were reported by Akcay et al. (2020) and Sobhay *et al*. (2019. Erkaya *et al.* (2015) observed no significant changes in in thermosonication- treated samples during shelf life. Also, Ozrink and Inci (2008) demonstrated that the TA of cow's milk is significantly greater in the winter than in the spring, as well as significant variation between cow farm locations. Additionally, Ibrahim *et al.* (2008) showed that the temperature at which the yogurt is incubated has a significant effect on the increased TA in goat and cow yogurt.

ii. **Titratable acidity influence day 28 between companies during the seasons:**

The findings in Fig. (4.4) show significant differences in the acidity of samples A, B, C, D, and E during the winter season; sample (D) has a mean acidity value that is significantly higher than all other samples, samples A and E have mean values that are significantly higher than samples B and C, Additionally, sample B generally shows a standard acidity value that is significantly higher than that of sample C. Also, in the spring, sample (D) has a significantly higher mean acidity than all the other samples, sample (A) has a significantly higher mean acidity than samples (B, C, and E), and sample (E) has a significantly higher mean acidity than samples (B, C). According to the Palestinian standard (PS 18-2-2019), the titratable acidity of drinking yogurt should be between 0.6 and 1.3. The findings indicate that the mean acidity values for all the companies under study fall within this range.

The findings also indicate that the two seasons (winter and spring) have a significant impact on the examined samples (A, D, and E). For example, samples A and D in the spring have significantly higher values than the corresponding values in the winter, in keeping with Mahmoudi *et al.*, (2014) findings, sheep yogurt samples showed a considerable increase in titratable acidity during the summer, surpassing that of the winter, furthermore, lactic acid generation and bacterial activity—especially that of lactic acid bacteria—are crucial. Similarly, Ozrenk and Inci (2008) verified that TA levels vary greatly from place to place and that TA is higher in the winter than in the summer. While sample (E) in the winter has significantly higher values than the corresponding mean in the spring but lower values than these three samples in the same time. However, for the samples (B & C), the results indicate no discernible differences between the two seasons (winter and spring). This may be due to the ability to control the quality of the product during its shelf life by controlling the main factors that affect the post-acidification of yogurt after fermentation, the most important of which are starter cultures, manufacturing parameters, stabilizers and other additives that should be used, and packaging materials, according to research conducted by Deshwal *et al.*, (2021).

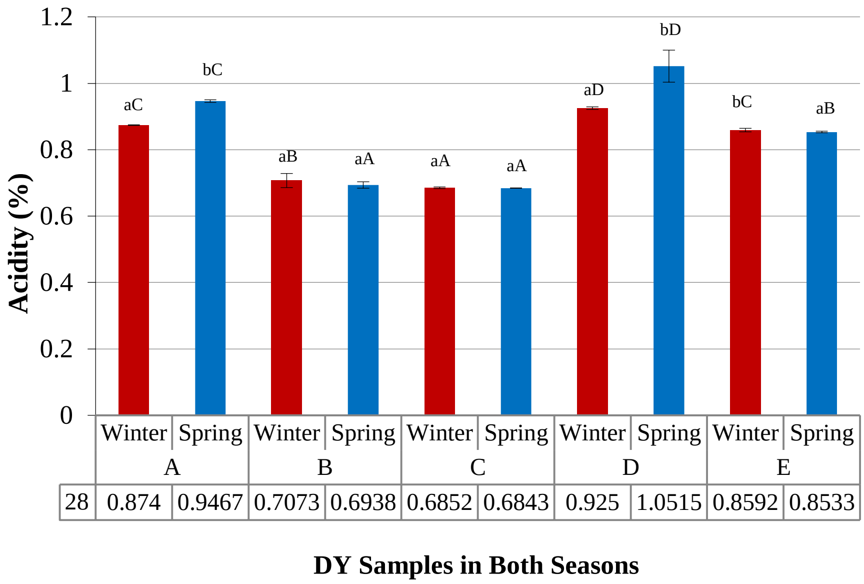


Fig. (4.4): The results of titrable acidity for samples at day 28 in both seasons for each sample. Comparison of differences between companies in a single season are shown by different capital superscript characters. Seasonal changes within a single sample are indicated by different lowercase superscript characters.

The findings generally show that the samples continued post-acidification over the time of the product's shelf life in both seasons. The fermentation process continuing throughout the storage period is the primary cause for the increase. Variations in the rate of pH decrease and acidity increase may be caused by a number of factors, including the milk's source, quantity, and composition (TS, Protein , Fat, etc) (Ozrenk and Inci, 2008), the percentage of water added and salt level (Köksoy & Kılıç, 2003), the type of starter culture used, the product's readiness before going on sale (Ibrahim *et al.*, 2019), and other additives like pectin and stabilizers that lower pH during and after manufacturing (Sobhay *et al.*, 2019), as well as preservatives that inhibit microbial growth and starter culture activity (Küçükçetin *et al.*,. 2008), production stages conditions of each company, pasteurization and processing techniques (Deshwal *et al.*, 2021). In addition, some samples may have microbial contamination, which has a significant impact on the acidity's stability (Hamad, 2012). Also, temperature has a significant impact on the stability of acidity, which is important during the manufacturing, fermentation, storage, and transportation phases and different the conditions in seasons (Ibrahim et al., 2019), (Ozrenk and Inci, 2008), as well as when monitoring the shelf life of samples. Because of the reactions that take place inside the product during preservation and storage, packaging materials and their different compositions also have a significant impact on the product's composition and acidification over time (Deshwal et al., 2021).

4.3.1.3 Chemical Composition of Drinking Yogurt:

(Moisture, TS%, SNF%, Fat%, Protein%, Ash and mineral's % and salt content)

During the winter season, an analysis of various samples indicated that the moisture content exceeded that typically found in cow's milk, which is generally about 88%. The data presented in table (4.3) reveal that Company C exhibited the highest moisture value.

Table (4.3): The results of macro-compositions contents of DY from differences samples according to the seasons for each company

Components		Moisture %	T.S%	S.N.F %	Fat %	Protein %
Sample	Seasons	Mean± S.D	Mean± S.D	Mean± S.D	Mean± S.D	Mean± S.D
A	Winter	89.907 ± 0.077^{aA}	10.093 ± 0.077^{bE}	7.909 ± 0.07^{bD}	2.183 ± 0.037^{aD}	4.458 ± 0.07^{bD}
	Spring	90.396 ± 0.35^{bB}	9.603 ± 0.35^{aD}	7.25 ± 0.37^{aE}	2.35 ± 0.05^{bE}	4.1983 ± 0.08^{aC}
B	Winter	90.42 ± 0.3^{aB}	9.576 ± 0.039^{bD}	7.6595 ± 0.389^{bD}	1.916 ± 0.0235^{aC}	3.80 ± 0.04^{bB}
	Spring	91.261 ± 0.067^{bC}	8.739 ± 0.0677^{aB}	6.822 ± 0.078^{aA}	1.9166 ± 0.037^{aC}	3.625 ± 0.025^{aA}
C	Winter	91.73 ± 0.042^{aC}	8.2607 ± 0.042^{aA}	6.744 ± 0.038^{bA}	1.516 ± 0.037^{bB}	3.75 ± 0.0408^{bA}
	Spring	91.832 ± 0.027^{aC}	8.167 ± 0.027^{aA}	7.134 ± 0.0436^{aB}	1.033 ± 0.047^{aA}	3.65 ± 0.0^{aA}
D	Winter	90.685 ± 0.199^{aB}	9.3145 ± 0.199^{aC}	7.2978 ± 0.179^{bC}	2.016 ± 0.037^{aC}	3.866 ± 0.023^{bB}
	Spring	90.879 ± 0.087^{aB}	9.1205 ± 0.087^{aC}	7.087 ± 0.106^{aB}	2.033 ± 0.047^{aC}	3.723 ± 0.047^{aB}
E	Winter	90.609 ± 0.27^{aB}	9.39 ± 0.27^{bC}	7.358 ± 0.259^{bC}	2.033 ± 0.047^{aC}	3.917 ± 0.024^{aC}
	Spring	91.125 ± 0.122^{Bc}	8.875 ± 0.122^{aB}	6.641 ± 0.089^{aA}	2.233 ± 0.047^{bD}	4.33 ± 1.12^{bD}

** Seasonal changes within a single season are shown by different capital superscript characters. Seasonal changes within a single sample are indicated by different lowercase superscript characters.

In contrast, the total solid (TS) content showed an inverse relationship with moisture content, with sample A demonstrating the highest average T.S., followed in descending order by samples B, E, D, and C, respectively.

The analysis further identified differences in solid non-fat (S.N.F.) and fat content among the companies. Sample C displayed the lowest S.N.F. and fat content, whereas Company A exhibited the highest values in these parameters. The ranking for S.N.F. was Company A followed by D, E, B, and C, with the fat content ranking similarly among the companies.

During the spring season, significant shifts were observed compared to winter. Moisture content increased across all samples, with sample C again showing the highest levels. Total solid content exhibited differences among companies, with sample A having the highest and sample C the lowest in the spring. S.N.F. and fat contents followed similar patterns to the winter season but were generally higher in the spring.

According to Beşir & Mortaş (2022), all TS rates ranged from (7.15 to 9.61). Furthermore, the rate of TS increased more in the winter than in the spring, which is consistent with previous research on raw milk increases depending on seasonal and geographical variation (location). Ramdani *et al.,* (2024) validated this in research of many farms in various regions, as well as in a study of the effect of the season on milk components, which was confirmed by Kabil *et al.,* (2015) and Ozrenk and Inci (2008). In winter, the season had a greater significant influence, whereas the location had no significant.

Fat content measurements were deviated from the Turkish Food Codex (0.8–1.2%) and the control sample average of 1.34% from Beşir and Mortaş (2022). Additionally, the samples varied significantly from one another and did not match the 1.5% label values for each manufacturer. Additionally, all product samples satisfied the PS: 18-2-2019, which verified that samples A, B, C, D, and E in both seasons had more than 1.5% full-fat drinking yogurt, with the exception of Company C in the spring, which had less than 1.5%. Seasonal variations in the firms' fat content were significant. Manufacturing processes like uniformity and the amount of water added may be connected to this change (Koksoy and Kılıç 2003). It so contradicted the results of earlier studies on the impact of season on raw milk, such as those conducted by Ozrenk and Inci (2008), Kabil *et al.,* (2015), and Ramdani *et al.,* (2024).

The SNF content rates were higher than 5.5% and varied by location and company, but seasonal differences had no discernible effect. This was in line with the PS:18-2-2019, which contradicted the Ramdani *et al.,* (2024) study on the impact of the season on milk components and concurred with Ozrenk and Inci (2008), who found no discernible effect of the season. In a survey of many farms in various areas, Ramdani *et al*., (2024) found that there were significant differences; however, Ozrenk and Inci (2008) confirmed that location had no effect on SNF content.

Protein content was also found to be higher than the typical levels observed in fresh cow's milk, with sample A having the highest average protein content, followed by Companies E, D, B, and C, respectively. Protein content remained highest in sample E during the spring.

Protein content levels were significantly higher than the control Ayran sample's average of 1.34%, as reported by Beşir and Mortaş (2022). However, the samples did not match each company's label readings, which ranged from 1.8 to 3.0% across all companies higher than label information. A significant variation in protein content among the companies indicates the season effect on the samples, with higher protein levels generally observed in winter compared to spring, except for sample E. Milk quality can vary depending on season and location, as well as process strategies like standardizing protein content with additives like CMP and SMP (Deschwal *et al.,* 2021), adjusting water amounts (Koksoy and Kılıç, 2003) and using stabilizers.

As a result, it is consistent with previous research on the effect of season on raw milk (Ramdani *et al.,* 2024), Kabil *et al.,* (2015), and Ozrenk and Inci (2008). In addition to the influence of location, Ramdani *et al*., (2024) confirmed that there was a substantial difference in protein content in various farms in different locations, although Ozrenk and Ince (2008) confirmed that there was no effect of location.

Table (4.4): The results of minerals contents of DY from differences samples according to the seasons for each company

Components		Ash %	Na (ppm)	Ca (ppm)	K (ppm)	Mg (ppm)
Sample	Seasons	Mean± S.D	Mean± S.D	Mean± S.D	Mean± S.D	Mean± S.D
A	Winter	9.0845±0.047^{aA}	49.326±0.479^{aA}	7.48±0.121^{aA}	25.84±0.44^{aA}	60.768±0.199^{aA}
	Spring	11.443±0.90^{bB}	64.12±0.59^{bB}	13.77±1.01 ^{aA}	41.09±1.03^{bC}	133.566±1.595^{bD}
B	Winter	7.793±0.26^{aA}	51.510±0.335^{aA}	7.922±0.154^{aA}	29.80±0.695^{aA}	67.87±1.616^{aA}
	Spring	13.827±1.38^{bC}	67.956±1.17^{bB}	18.462±0.64^{aA}	42.389±1.74^{bC}	203.615±1.29^{bE}
C	Winter	7.691±0.266^{aA}	54.645±0.348^{aA}	8.478±0.39^{aA}	31.71±0.709^{aB}	79.568±0.487^{aB}
	Spring	15.38±1.50^{bD}	59.09±0.079^{aA}	20.25±0.536^{aA}	49.09±1.239^{bC}	340.8±1.55^{bF}
D	Winter	8.42±0.32^{aA}	47.187±0.468^{aA}	7.587±0.208^{aA}	28.456±0.94^{aA}	73.45±0.78^{aB}
	Spring	10.622±0.097^{bB}	59.11±0.923^{aA}	12.26±0.153^{aA}	36.01±0.164^{bB}	111.015±1.13^{bC}
E	Winter	7.823±0.16^{aC}	54.705±0.577^{aA}	8.94±0.29^{aA}	27.15±1.25^{aA}	72.93±0.29^{aB}
	Spring	10.635±0.092^{bB}	65.224±2.253^{bB}	13.15±0.108^{aA}	32.57±0.549^{bB}	122.166±0.249^{bD}

** Seasonal changes within a single season are shown by different capital superscript characters. Seasonal changes within a single sample are indicated by different lowercase superscript characters.

The ash content in drinking yogurt exceeded that of fresh milk. During the winter months, Sample A demonstrated the highest ash content, with a descending order of Sample D, E, B, and C. Conversely, in the spring season, the pattern shifted, with Sample C leading, followed by Samples B, A, E, and D. The ash content levels were significantly greater than the control Ayran sample's average of 1.18%, It was consistent with Beşir and Mortaş (2022).

Macro-mineral analysis revealed relatively consistent levels of sodium and calcium across the companies, with high variations in potassium and magnesium levels. Also, the sodium and calcium amounts were closely clustered among the samples, and they were inconsistent with each company's label readings. While potassium and magnesium levels showed greater variability, with sample C generally having the highest concentrations in both seasons.

Ash content and mineral analysis continued to show variations, with magnesium levels in particular rising sharply in the spring compared to winter.

As Seen, results disagreed with Kang *et al.*, (2019) because it differed significantly in mineral content from the local DY product, which may be attributed to differences in product type, ingredients, amount of water added...etc. The DY product also contains a high concentration of minerals, which could be attributed to the added salt, the amount of water (about 30%) maybe mineral-rich, the source of milk, the type of feed used, and the effect of the season, as the results showed a significant increase in all minerals in the spring compared to the winter. This observation contrasts with Orzenk and Inci's (2008) research, which found minimal seasonal variation and suggested a slight increase during the summer months.

Table (4.5): The results of salt content of differences samples according to the seasons for each company

Salt content %	Winter	Spring
Sample	Mean± S.D	Mean± S.D
A	0.7008 ± 0.0^{aA}	0.7008 ± 0.0^{aA}
B	0.7495 ± 0.0137^{aA}	0.7485 ± 0.009^{aA}
C	0.6277 ± 0.015^{aA}	0.6148 ± 0.0024^{aA}
D	0.739 ± 0.036^{aB}	0.7104 ± 0.0002^{aA}
E	0.7446 ± 0.015^{aA}	0.766 ± 0.0087^{aB}

** Seasonal changes within a single season are shown by different capital superscript characters. Seasonal changes within a single sample are indicated by different lowercase superscript characters.

Salt content across all companies remained below 1%, with sample C showing the lowest levels and sample E the highest.

In summary, the results underscore significant differences in product composition across companies and between seasons, likely due to variations in production processes and raw material sources, especially raw cow's milk (Deschwal *et al.,* 2021), which is thought to be most impacted by the season, the kind and type of feed, the milking technique, farm management, new-borns, lactation stages, illnesses, mastitis and other factors affecting milk properties(Orzenk and Inci, 2008) ,(Ramdani *et al.*, (2024), Kabil *et al.*, (2015).These factors have a significant impact on the milk's solids, fats, protein, ash and minerals, as well as the product's quality and stability over time. While the nutrient density remained high across all samples, further research is needed to fully understand these differences and their impact on product quality and consumer preferences.

4.3.1.4 Dose and concentration of preservatives in a drinking yogurt: Potassium Sorbate:

The sorbate concentration analysis revealed marked differences in the amount of sorbate that samples A, B, C, D, and E contain throughout the winter, as illustrated in Fig. (4.5). the sorbate content of sample (A) is much higher than any other sample. Samples E and B demonstrated moderate sorbate concentrations, while Samples C and D displayed minimal, statistically non-significant sorbate levels. However, In the spring, sample (E) had a high amount of sorbate (107 ppm), which is significantly higher than all the other samples. Conversely, Samples B, C, D, and A showed negligible sorbate quantities, with differences among these samples with non-significant statistical differences.

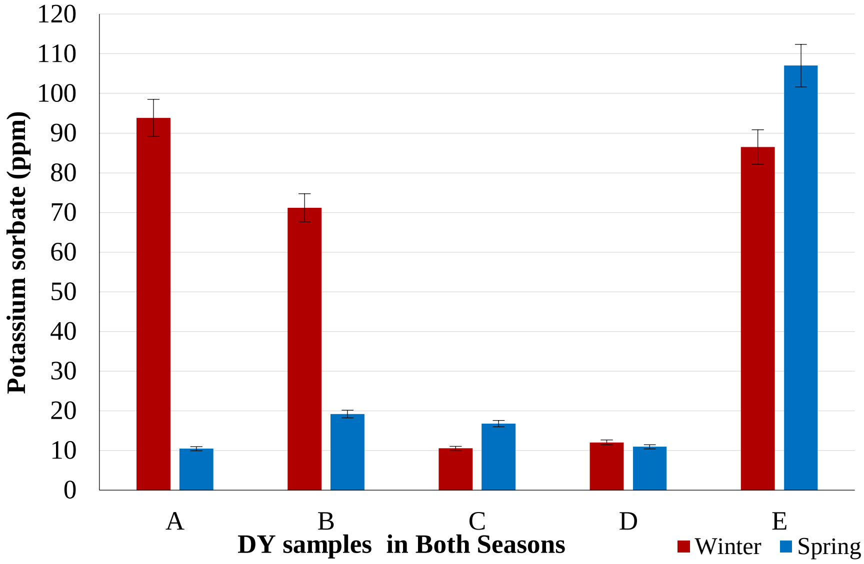


Fig.(4.5): Influence of seasons on preservative- sorbic acid content (ppm) of drinking yogurt sample stored in refrigerator at 8C.

These findings also indicate that the mean potassium sorbate values in all of the samples are higher than the maximum Palestinian standard (PS 18-2-2019) range, which state that neither potassium sorbate nor sorbic acid should be found in the DY product in the winter or spring. However, samples C and D have only a small amount of sorbate in both seasons, and samples A and B have little sorbate in the spring.

With the exception of sample (E), which clearly shows the year-round use of sorbates in high quantities reaching roughly 100 ppm. These results suggest that manufacturers are attempting to commit to minimize sorbate usage, particularly during spring season. The residual low-level sorbate detected in some samples could potentially originate from biological sources, such as starter culture residues or inherent product additives, as previously documented by Zacharof and Lovitt (2012).

The findings were comparable to those of studies by Mazdeh *et al.*, (2014) on Ayran yogurt drinks and Amirpour *et al.*, (2015) on Doogh yogurt drinks, which found no sorbates in all but two samples, while Kucukcetin *et al.*, (2007) demonstrated that no sorbates were found in any Doogh product samples.

Regarding each company's label, companies A, B, and E indicated that they included sorbate in both seasons, but companies A and B contained extremely minor amounts in the spring. In contrast, Companies C and D made no mention of sorbate on their product labels. Correspondingly, the analytical results for these companies showed trace sorbate amounts that were statistically insignificant. The matching of label declarations and laboratory analysis enhances the credibility of the companies in reporting ingredient compositions.

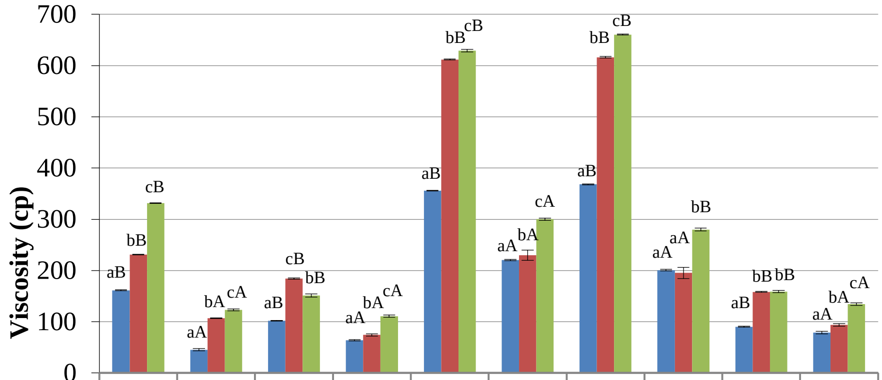
The drop in sorbates in the spring could be attributed to the official authorities' follow-up with these companies regarding the necessity of not using sorbates in the yogurt drink product, which has influenced their use of sorbates in the spring. The absence or reduction of the amount used could have been due to necessity productive practices or the desire to follow the directions and requirements of the Palestinian standard.

4.4 Rheological Properties of Drinking Yogurt:

4.4.1 Viscosity:

i. Seasonal influence of the viscosity between companies during the shelf life:

The viscosity results of drinkable yogurt samples from five companies (A-E) over 28 days during winter and spring indicate significant differences in product consistency influenced by time and season.



	A		B		C		D		E	
	Winter	Spring	Winter	Spring	Winter	Spring	Winter	Spring	Winter	Spring
0	161.42	45.462	101.87	63.867	355.62	220.53	368.17	200.73	90.28	78.713
14	231.32	107.02	184.2	74.233	611.8	229.88	616.23	195.4	158.42	93.942
28	331.32	123.28	151.22	110.95	629.13	300.15	660.57	280.02	158.83	134.4

DY Sample in Both Seasons

Fig. (4.6): The results of viscosity (cp) samples according to the test days and seasons for each sample. Seasonal changes within a single day are shown by different capital superscript characters. Variations within the same season are indicated by different lowercase superscript characters.

In Figure 4.6, samples A through E exhibit a clear change in viscosity over a 28-day period in both winter and spring seasons, showing different thickening behaviors and responses to seasonal conditions.

Sample (A): Viscosity increases significantly ($p<0.05$) from day 0 to day 28 in both winter and spring. Winter values are consistently higher than spring values, with the largest difference observed on day 28. This pattern suggests a progressive thickening effect, due to presence of stabilizers as stated (E406 – Agar) and its interactions with proteins over time.

The higher winter viscosity may result from lower temperatures slowing the breakdown of these stabilizing agents, enhancing the structure and thickness of the product.

Sample (B): This sample shows a similar trend to Sample A, with viscosity increasing significantly from day 0 to day 28 in both seasons. However, the seasonal increase is more moderate, indicating that Sample B may have a more stable formulation and is less affected by temperature variations. This stability suggests a formulation with balanced properties, maintaining consistency in both winter and spring, even though viscosity peaks at day 28. It should be noted that the producer use of gelatin as a stabilizer was specified; this does not adhere to PS: 18-2-2019. Notice that gelatine is made up of amino acids linked together by peptide bonds, primarily proline, hydroxyproline, and glycine. Which form a cohesive and strong gelatinous layer, thickening and gelling the product, and is affected by pH, temperature, stabilizers' concentration, and production practices, all of which influence the product's viscosity and stability (Tasneem *et al.,* 2014).

Sample (C): Viscosity also rises significantly over time in both winter and spring, with day 28 being the highest in both cases. Winter measurements are consistently higher than those in spring, and the differences are most pronounced on day 28. This pattern indicates substantial thickening, likely due to microbial activity, fermentation, or specific stabilizers that are more effective in cool temperatures, leading to a marked increase in viscosity by the end of the period. Take note that the product's label lists the pectin content as a stabilizing agent. The viscosity enhancement may be attributed to the product's pectin content, which serves as a stabilizing agent. Pectin's molecular characteristics enable it to form a gel-like network, increasing the drinking yogurt's structural integrity and resistance to flow. The variation in viscosity between winter and spring could be influenced by pectin's temperature-sensitive interactions with milk proteins and its gel-forming capabilities (Noor et al., 2021).

Sample (D): Viscosity in winter rises progressively from day 0 to day 28, with each day showing a higher value than the last. In spring, viscosity on days 0 and 14 remains similar, but both are lower than on day 28. Note that the manufacturer did not specify the type of stabilizer used, which aids in determining the cause of the stability, although it might be related to manufacturing procedures, production practices and the stability of acidity on the 14th of the spring, which also affected the stability of viscosity on this particular day. Winter values are consistently higher across all days, with the highest viscosity reaching nearly 700 cp on day 28, indicating a strong thickening effect. This increase may be due to higher stabilizer concentrations or a more active fermentation process in cooler temperatures, resulting in significant viscosity development over time. Notably, the package label did not specify the kind of stabilizer.

Sample (E): In winter, viscosity on day 0 is significantly lower than on days 14 and 28, which do not significantly differ from each other. In spring, viscosity rises progressively from day 0 to day 28. Winter values are consistently higher than those in spring, but Sample E maintains the lowest viscosity overall across all seasons and time points. This suggests that Sample E has a formulation that encourages minimal viscosity development, possibly due to a lower concentration of thickening agents or a composition that does not promote substantial thickening over time. Notably, as seen in samples C, the product label cites pectin content as a stabilizing ingredient. The consistency and viscosity of the two commodities fluctuated dramatically throughout the storage duration in both seasons. This could indicate differences in the type of pectin, how it is blended, and how much is used (Tasneem et al., 2014), as the quantity of stabilizers increased, so did the perceived viscosity (Koksoy and Kilic, 2004). The type and dosage of starter culture used may have an impact on the product's consistency (Widyastuti *et al.*, 2014), as well as the milk-to-water ratio (Koksoy and Kilic, 2003).

In summary, each sample demonstrates unique thickening characteristics. Samples A and C show a pronounced increase in viscosity, especially in winter, while Samples B and D maintain greater stability, indicating balanced formulations. Sample E has the lowest viscosity, suggesting a different formulation with minimal viscosity development.

The data indicates that viscosity in drinking yogurt is influenced by both the duration of storage and seasonal temperature variations (Li et al., 2021) and type of stabilizers used (Tasneem et al., 2014). Higher viscosities in winter suggest that cooler temperatures favor the thickening process, possibly due to reduced enzymatic activity that would otherwise break down the yogurt's structure. The variation among companies points to differences in formulation and processing that impact the final product's consistency (Hachana *et al.*, 2017), (Ibrahim *et al.*, 2021).

ii. The viscosity influence at day 28 between companies during the seasons:

Figure (4.7) shows that the viscosity of samples A, B, C, D, and E on day 28 varies significantly ($P<0.05$) in both winter and spring seasons. In winter, Sample D has the highest viscosity, followed by Samples C, A, E, and B respectively. In spring, Sample C has the highest viscosity, followed by Samples D, E, A, and B respectively. Across all samples, winter viscosities are higher than those in spring, indicating that seasonal variation has an important impact on viscosity for all samples studied.

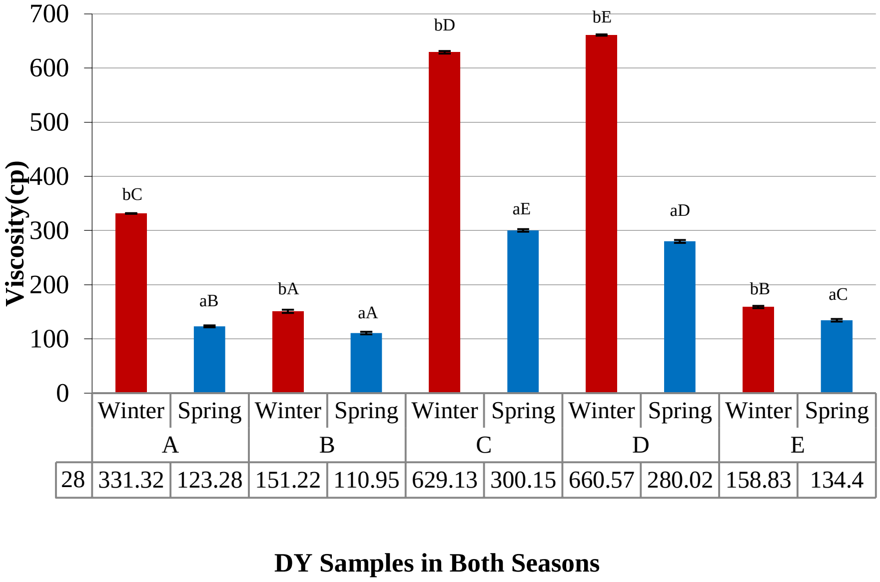


Fig. (4.7): The results of viscosity (cp) for samples at day 28 in both seasons for each sample. Comparison of differences between companies in a single season are shown by different capital superscript characters. Seasonal changes within a single sample are indicated by different lowercase superscript characters.

It was also revealed that pH and acidity readings influenced viscosity, with a fall in pH resulting in an increase in product acidity and thus an increase in product viscosity in all companies during the two seasons. Product viscosity was also shown to be altered by season and storage temperatures, with winter viscosity much higher than spring viscosity, with Company D having the lowest pH, highest acidity, and high viscosity rate across both seasons This is consistent with Li *et al.,* (2021), but not with Akbulut and Bozkurt, (2020).

Several factors influenced the viscosity seasonal differences such as: temperature, production conditions, milk composition, protein content, and characteristics of casein particles (Sobhay et al., 2019) and quantity of milk used (Beşir and Mortaş, 2022). Temperature fluctuations affect the molecular interactions, between casein particles and different stabilizers used, playing a crucial role in determining the viscosity(Koksoy and Kilic, 2004). It could also be the result of both fat and protein decomposition, changes in the chemical composition of the product caused by acids, gases, and enzymes that alter the product's properties, and an increase in specific biomass (Wang etal.,2021). Furthermore, differences in pH, acidity (Akbulut and Bozkurt, 2020), heat treatment, and processing methods (Erkay et al., 2015), as well as the types and concentrations of hydrocolloids and stabilizers, can all contribute to the crosslinking of molecules, thereby increasing viscosity. (Koksoy and Kilic, 2004).

Furthermore, type of starter cultures, their concentrations and incubation temperature, can significantly affect viscosity by producing exopolysaccharides in the media enhancing thickness. (Ibrahim *et al.,* 2019), (Hachana *et al.*, 2017). Storage time is another factor affecting viscosity; as storage time progresses, partial evaporation of H_2O molecules leads to increase in the concentration of solids, causing viscosity increase (Béal and Helinck, 2014). This complex relationship between ingredients, processing conditions, and storage time may be responsible for the observed variations in viscosity across samples and seasons.

4.4.2 Serum Separation and Water Holding Capacity:

Figure (4.8) showed the difference in serum separation between companies and during seasons. In winter, serum separation appeared in company D higher than the other companies (B and E), while no separation appeared in companies (A and C). In spring, serum separation decreased in companies in general, but company D was higher than company B, while other companies (A, C, and E) did not show any separation. Serum separation occurs in fermented milk products as a result of casein micelles aggregating to particles, particle movement, and sedimentation under gravity during storage. High concentrations of some stabilizers reduced serum separation to none (Erkay et al., 2015). According to Stokes' law, the viscosity of a continuous phase causes gravitationally induced phase separation to decrease and increase with particle size (Koksoy and Kilic, 2004). The reasons for the association of yogurt drink in some companies and the absence of any separation and its appearance in others may be due to the type of stabilizer used, the method of preparing the product, and the type of starters used (Pakbin et al., 2015). They play a major role in the association and cohesion of protein molecules (Koksoy and Kilic, 2004). The stability of acidic yogurt drink depends on many factors including pH range, protein content, heterogeneous polysaccharides, temperature...etc (Pakbin et al., 2015). The physicochemical qualities of milk are influenced by seasonal variations, which in turn impacts the quality, structure and rheological properties of dairy products (Li et al., 2021), including: viscosity, serum separation and syneresis, WHC...etc.

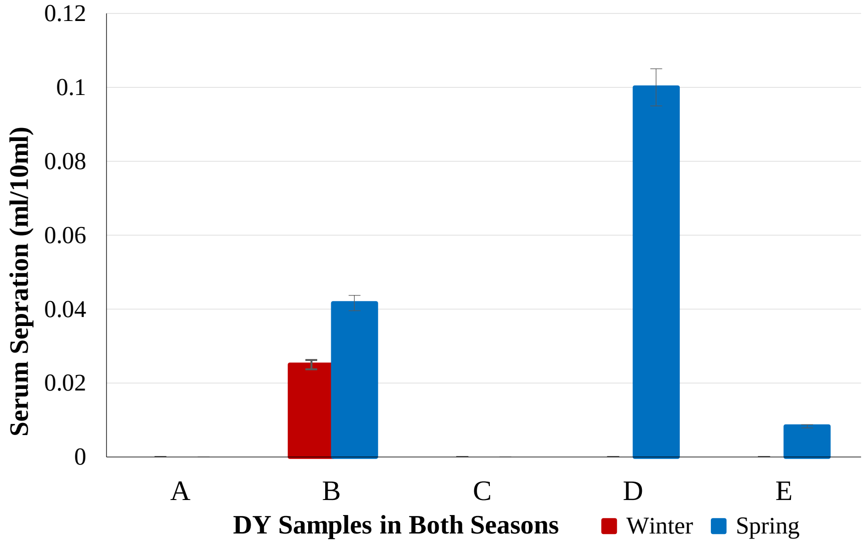


Fig.(4.8) : Influence of seasons on serum separation (mL/10mL of sample) of drinking yogurt sample stored in refrigerator at 8C per 15 days

As for the water holding capacity, fig. (4.9) showed a difference between the companies during the two seasons. In winter, company B was higher than the other companies (D, E, C, and A), respectively. In spring, company B was also the higher than other companies (H, D, C, and A), respectively. The results also showed that the water holding capacity in winter was higher than in spring, and that is consistent with Li et al., (2021). The reasons for increased water binding capacity in the drinking yogurt in some companies than others may be due to the percentage of milk content in the product, total solids content, and the dose of additives, including stabilizers and starter cultures used, as they play a major role in cohesion of the molecules of yogurt network bonds. The water holding capacity in the drinking yogurt depends on some factors, including the total solids content, protein content, type of stabilizers and concentration and other additives, water percentage, etc (Macit and Bakirci, 2017). The physicochemical properties of milk are affected during the seasons, which in turn affect the structure and rheological properties of the drinking yogurt, as already stated.

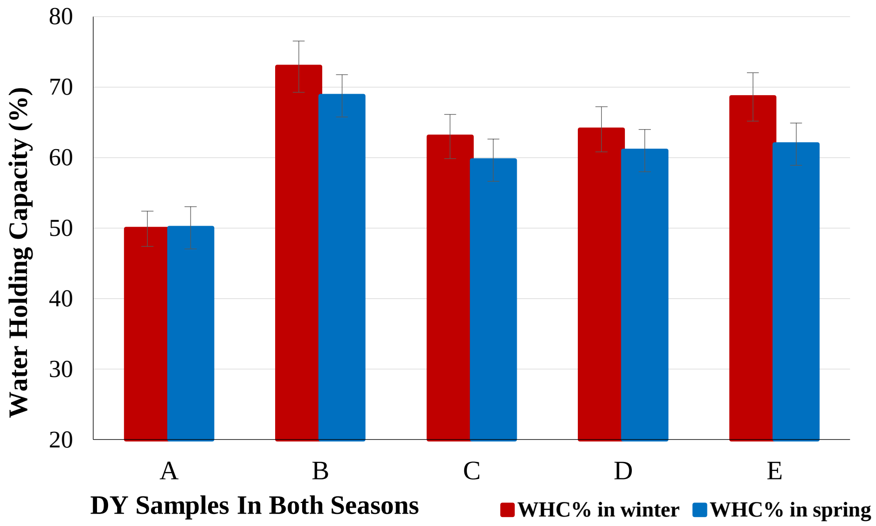


Fig.(4.9) Influence of seasons on water holding capacity percentage (WHC %) of drinking yogurt sample using centrifuge 10 minutes.

In terms of Turkish Ayran yogurt, they confirmed the important effect on the separation of serum in it, namely Koksoy and Kilic (2004) the effect of the type of stabilizer, and Erkaya et al., (2015) showed the effect of heat treatment; Beşir & Mortaş (2022) explained the effect of the milk ratio and other additives, and Akbulut & Bozkurt (2020) the effect of the pH of readiness, while Pakbin et al., (2015) showed the effect of the type of starter on Iranian Doogh.

4.4.3 Density:

Figure (4.10) shows the extent of variation values in drinking yogurt density between companies and during seasons, as each company has a different production recipe and processing system, and the difference of the bovine milk source, locations, feeding and season affects its composition and physicochemical properties (Ramadhani et al., 2024), which affect the consistency of the dairy product and its rheological properties. Noted that during the spring season, the density was higher than in the winter season for all samples. Company D was higher than the other companies (C, A, B, and E), respectively.

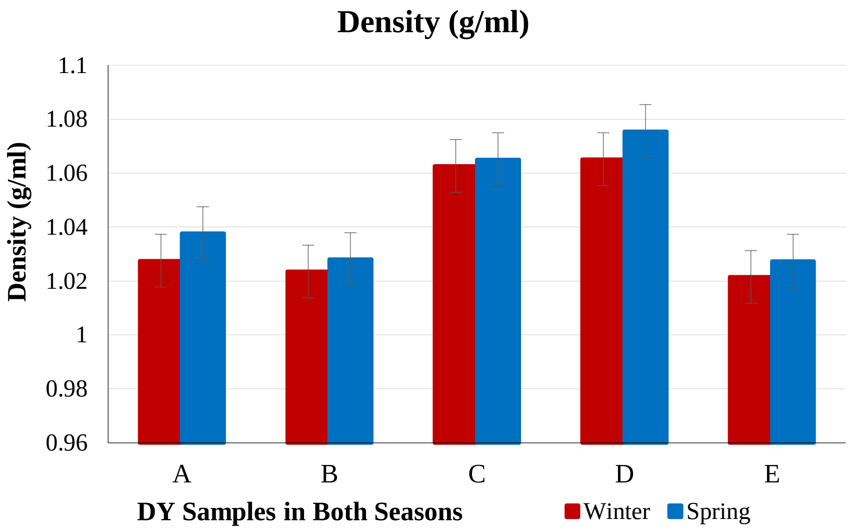


Fig. (4.10) : Influence of seasons on density (g/ml) of drinking yogurt sample stored in refrigerator at 8C.

All results were identical to Kiani's (2008) rates of 1.021 to 1.06 g.cm-3 for Iranian Doogh drink in both seasons. As demonstrated by Parmar et al. (2020) in their investigation into the seasonal impact on raw milk density, which revealed that spring had the lowest density readings, and by Ramadhani et al. (2024) in their investigation into the seasonal impact on raw milk, which verified a significant rise in density during the winter, as well as their study of the farm location, which discovered notable variations among locations. The reason for the increase in density in the drinking yogurt in the spring season may be due to the improvement in the quality of cows' nutrition and farm management, the moderate weather that reduces animal stress and improves their health, the increase in the vital activity of the animals, the decrease in the incidence of diseases, and the increase in the percentage of fats and non-fatty substances, this is consistent with our findings, which show that they are higher in the spring than in the winter, regardless of the percentage of milk added to the percentage of water, the standardization process, or manufacturing practices.

4.5 Microbiological Quality parameters of a drinking yogurt :

4.5.1 Microbial quality: Pathogen and spoilage microorganism:

4.5.1.1 Colifom and Fecal Analysis:

There were no coliform and Fecal bacteria in all drinking yoghurt samples either fresh or during cooling storage, this maybe the result of the heat treatment efficiency of the different yoghurt milks and sterilization and sanitization conditions during processing, tightly closed the bottles and storage of drinking yoghurt and the effect of acidity in different drinking yoghurt samples which prevent pathogenic bacteria growth. The results are in consonance with the results of (Sobhay, et al., 2019 and El Batawy, 2012).

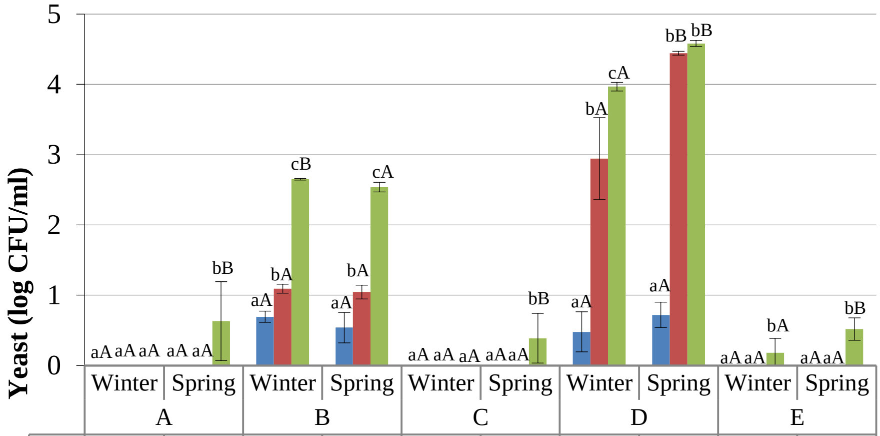
4.5.1.2 Yeast and Mold Analysis :

The yeast and molds families are microorganisms that play a main role in food spoilage. They cause major problem in the fermented dairy products is due to the organisms' growth proficiency at lower pH values. The occurrence of yeast and mold is a frequent and common problem during the shelf life and storage conditions.

A. **Yeast Analysis:**

i. Seasonal influence of yeast growth between companies during the shelf life

The analysis of mold growth in drinkable yogurt samples from five companies (A-E) over 28 days during winter and spring were slightly significant based on time and seasonal conditions.



	A Winter	A Spring	B Winter	B Spring	C Winter	C Spring	D Winter	D Spring	E Winter	E Spring
0	0	0	0.6931	0.5396	0	0	0.4792	0.7204	0	0
14	0	0	1.0928	1.0454	0	0	2.9445	4.4459	0	0
28	0	0.6303	2.6515	2.5374	0	0.387	3.9696	4.582	0.1799	0.5188

DY Samples in Both Seasons

Fig. (4.11): The results of yeast (log CFU/ml)) samples according to the test days and seasons for each sample. Seasonal changes within a single day are shown by different capital superscript characters. Variations within the same season are indicated by different lowercase superscript characters.

In Figure 4.11, samples A through E demonstrate an observable change in yeast growth over a 28-day period time in both winter and spring seasons, indicating different growth patterns and seasonal responses.

For Sample A, all yeast readings during winter were zero, indicating no fluctuations between days 0 and 28, suggesting that there are no fluctuations in yeast between the winter days of day 0 and day 28. The data show that the yeast in the spring for product (A) increases significantly over time, with the mean yeast on day 28 being significantly higher than on days 0 and 14, respectively. No significant seasonal differences were observed on days 0 and 14, but by day 28, yeast counts were significantly higher in spring than in winter. This indicates improved yeast control and specific product attributes. It ought to be noted that the use of sorbates appeared in the winter rather than the spring, which may have contributed to the appearance of yeast growths on the 28th day of spring. These findings were consistent with Jakubowska and Karamucki (2019), indicating that the microbial quality of the yogurt samples tested was high.

Sample (B) indicated that there were substantial differences between day 0 and 28 in both seasons. The yeast growth rate increased dramatically with time in both seasons. As a result, the findings indicate that the amount of yeast for product (B) increased considerably with time during the winter and spring. Furthermore, the results of day 28 show that there are considerable changes in yeast between the two seasons (winter and spring), with the average yeast concentration in winter being much higher than in spring. However, the findings demonstrate that there is no significant difference between the seasons between days 0 and 14. Even though sorbate is used in winter, its effect is considered weak, due to high contamination rates or inadequate hygiene during production particularly during the winter. Seasonal impacts on yeast growth, consistent with Moh et al. (2017), highlight greater yeast proliferation in dry seasons compared to wet seasons. These results also align with findings by Arakłi and Küłüköner (2003), Matin et al. (2018), and Uzay et al. (2020).

Sample (C) shows that there is no variation in yeast levels between days (0, 14, 28); absence yeast growth during the winter. There are notable variations in the spring, as the statistics show. For instance, during the winter, the product (C) has significantly more yeast on day 28 than on days 0 and 14. Days 0 through 14 show no variations in yeast between the winter and spring seasons. By day 28, however, the data indicates that the winter and spring yeasts count differ significantly at the 0.05 level. According to Jakubowska and Karamucki (2019), these findings supported the notion that the yogurt samples under investigation had good health quality and improved yeast control and distinct product attributes.

Sample (D): yeast growth increases significantly from day 0 to day 28 in both seasons. Spring readings were generally higher than those in winter on days14 and 28. Furthermore, the results of day 0 reveal that there are no major differences in yeast between the two seasons (winter and spring). This demonstrates the significant impact of the season on yeast growth, in addition to GMP during the manufacturing, packaging, and shipping processes (Moh et al., 2017). These findings are consistent with the large fall in pH and increase in acidity in both seasons, and they may possibly explain the increased viscosity in this product. The results further support the absence of sorbates in the samples lack of general hygiene control and monitoring during the manufacturing and packaging processes. According to Saadi (2024), fungi also had an impact on the product's consistency and texture, which in turn influenced its viscosity. This could led the product to become more viscous in both seasons of its shelf life. these results are in accordance with Arakłi and Küłüköner (2003), Matin et al. (2018), and Uzay et al. (2020).

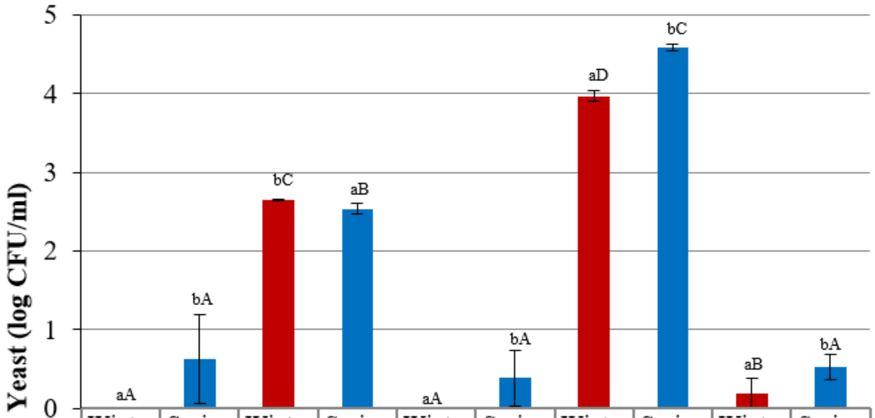
With regard to sample (E), the findings indicate that the yeast varies significantly over the days (0, 14, 28). The results indicate that the yeast for product (E) is growing significantly by days in both the winter and spring, with day 28 being significantly higher than days 0 and 14. Finally, the product's results for day 28 demonstrate a significant difference in yeast between both seasons (winter and spring), with the mean of spring yeast being significantly higher than that of winter. Jakubowska and Karamucki (2019) concurred with these findings, indicating that the yogurt samples under examination had good quality. One of the explanations could be the high concentration of sorbates (Dehghan et al., 2018). or the factory's ability to control health conditions throughout manufacturing processes. The data also show that spring is higher than winter due to the seasonal effect on fungus development (Moh et al., 2017).

The growth behavior of yeast during the period storage (28 days) of drinkable yogurt was shown in Fig. (4.11). In spring, yeast growth was more pronounced compared to winter across all companies. By day 14, significant yeast proliferation was observed, particularly in spring, persisting through day 28. By day 28, yeast levels remained high or increased slightly for most samples, particularly in spring, suggesting that season temperatures affect yeast activity. Furthermore, the drop in pH and the increase in acidity of the product in general hinder bacterial growth while increasing fungal development (Pal, 2014 Hossain et al., 2024 Moh et al., 2017). It is noted that yeast proliferation underscores the importance of temperature management in maintaining product quality and consistency over time.

ii. Yeast growth influence at day 28 between companies during the seasons:

Fig. (4.7) demonstrates significant variation ($P<0.05$) in yeast samples A, B, C, D, and E on day 28 over winter and spring seasons. In the winter, Sample D has the maximum yeast growth, followed by Samples (B and E), and then (A and C), both with zero means. In spring, Sample D had the largest yeast growth, followed by Sample B, which outperformed the other firms (A, C, and E) with zero means. Across all samples, yeast growth in spring is greater than that in winter, demonstrating that seasonal fluctuation has a significant impact on yeast growth in all samples tested.

However, the findings show that there are substantial changes in yeast between the two seasons (winter and spring) for all samples A, B, C, D, and E. Furthermore, samples A, C, D, and E have much higher values in the spring than they do in winter. This is consistent with the seasonal effect on yeast growth, as demonstrated by Moh et al., (2017). Except for sample B, which is substantially greater in winter than in spring, such could be due to working personnel' lack of knowledge, lack of sufficient training, and a poor ability to control health conditions throughout all production operations.



	Winter	Spring	Winter	Spring	Winter	Spring	Winter	Spring	Winter	Spring
	A		B		C		D		E	
28	0	0.6303	2.6515	2.5374	0	0.387	3.9696	4.582	0.1799	0.5188

DY Samples in Both Seasons

Fig. (4.12): The results of yeast (log CFU/ml) for samples at day 28 in both seasons for each sample. Comparison of differences between companies in a single season are shown by different capital superscript characters. Seasonal changes within a single sample are indicated by different lowercase superscript characters.

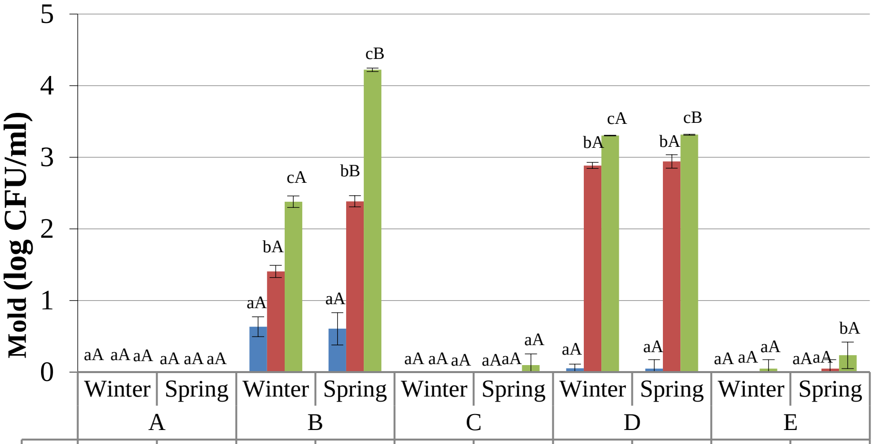
The results also show that all the samples have yeast mean values less than the maximum Palestinian standard (PS 18-2-2019) range of the total numbers of viable yeast and mold should not exceed 100 cfu/ml, which is equivalent to 2 log cfu/ml during the storage time in winter and in spring except the samples (D & B), whose yeast mean values are higher than the standards.

Usually, most yeast growth occurs in dry seasons more than in the winter due to its ability to resistance and induration. The yeast number increases as a result of poor handling during manufacturing processes, insufficient hygienic conditions, and environment pollution (Moh., 2017).

B. Mold Analysis:

i. Seasonal influence of mold growth between companies during the shelf life:

The analysis of mold growth in DY samples from five companies (A-E) over 28 day during winter and spring reveals significant variations based on time and seasonal conditions. In Figure 4.13, samples A through E demonstrate a clear change in mold growth over a 28-day period in both winter and spring seasons, indicating differing growth habits and reactions to seasonal conditions.



	A Winter	A Spring	B Winter	B Spring	C Winter	C Spring	D Winter	D Spring	E Winter	E Spring
0	0	0	0.6353	0.6059	0	0	0.0525	0.0502	0	0
14	0	0	1.4053	2.3863	0	0	2.8854	2.9435	0	0.0502
28	0	0	2.382	4.2226	0	0.1003	3.3056	3.3163	0.0502	0.2354

DY samples in Both Seasons

Fig. (4.13): The results of mold (log CFU/ml) samples according to the test days and seasons for each sample. Seasonal changes within a single day are shown by different capital superscript characters. Variations within the same season are indicated by different lowercase superscript characters.

The results of sample (A) show that there are no differences in mold between the days (0, 14, and 28) in winter and in spring, since absence of mold growth . According to Jakubowska and Karamucki (2019), these results confirmed that the yogurt samples that were being studied had high quality product, enhanced mold control, and good health quality (Matin et al., 2018).

In sample (B), mold growth increased significantly from day 0 to day 28 in both winter and spring. While there were no notable seasonal differences observed on day 0, mold growth on days 14 and 28 was significantly higher in spring than in winter. Sample (B) had the highest mold growth of any company, particularly in the spring. pH significantly dropped on the 28day in spring; may have provided an ideal setting for mold growth. This suggests that environmental factors, like higher temperatures and humidity in the spring, greatly accelerate the growth of mold (Du et al., 2021). Additionally, it confirms the lack of control over hygiene, as well as noncompliance with GMP rules in this factory, and may be a sign of inadequate preservatives or packaging that is unable to prevent mold growth in such circumstances. This aligns with observations by Moh et al. (2017) and Büchl and Seiler (2011), who noted that a sharp decrease in pH promotes fungal development. Furthermore, the sudden pH drop rendered yoghurt has an ideal environment for fungal development (Büchl and Seiler, 2011). The results of the study are consistent with those of Arakłi and Külüköner (2003) regarding flavored yogurt, Matin et al. (2018) on yogurt samples, and Uzay et al. (2020) on Ayran.

Since all of the mold values for sample (C) were absent. No significant variations in mold levels were observed between days 0, 14, and 28 or between seasons. On day 0, the conditions are identical to those on day 14, which is not appreciably different from those on day 28. This suggests effective microbial control, possibly due to apply HACCP, GMP, sanitation (Pal, 2014), or maybe use of antifungal agents or better packaging methods that limit mold exposure. These results corroborated the idea that the yogurt samples under study had superior quality, enhanced Mold control, and unique product features (Jakubowska and Karamucki, 2019).

Mold growth in sample (D), in both winter and spring, increased significantly from day 0 to day 28. The count was substantially greater on day 28 in both seasons than it is on days 14 and 0. However, since the two means are not significantly different, there are no significant variations between the results of days 0 and 14 for the two seasons (winter and spring). But on day 28, shows that the winter mean is significantly lower than the spring mean. As the results of sample D recorded a steady increase in mold growth over time in both seasons. This trend points to possible inefficiencies in controlling mold over time, with environmental factors playing a significant role in accelerating mold proliferation, such as springtime's higher temperatures and humidity, significantly hasten the formation of mold (Du et al., 2021). Sample (D) had the lowest pH readings and the greatest acidity and viscosity, as well as the highest mold growth and fungi. This may indicate the lack of control over sterilization and cleaning, as well as possibility of noncompliance with GMP rules in this facility, resulting in flaws in the manufacturing processes and an urgent need for follow-up by quality control lab. Similar findings were reported by Moh et al. (2017) in Shalom yogurt, and Büchl and Seiler (2011) attributed abrupt pH drops to fungal development. Results of this study are consistent with those of Matin et al. (2018) with yogurt samples, Arakłi and Küłüköner (2003) regarding flavored yogurt, and Uzay et al. (2020) regarding Ayran.

The results of sample (E) indicated that there are not any significant variations in mold between days 0–14 and 28 during the winter season. However, in the spring mold counts on day 28 were significantly higher than on day 0, but no differences were observed between days 0 and 14. Additionally, the results of the company's product (E) for days 0, 14, and 28 indicate that there were no significant variations between the two seasons (winter and spring). Low mold growth in spring, with minimal increase over time, indicates strong mold control mechanisms, possibly through adding preservatives (Dehghan et al., 2018), maintaining sterilizing conditions and monitoring all production operations (Pal, 2014) or effective storage conditions that inhibit mold growth even as the product ages. It also illustrates the seasonal variation in the occurrence of fungal growths. (Moh et al., 2017)

ii. Mold growth influence at day 28 between companies during the seasons:

As shown in the results Fig. (4.14), there were significant distinctions in mold between the samples A to E during the both of seasons. In winter months, sample (D) has significantly higher mold count than all other samples (B, E, C, and A), respectively. Moreover, in the spring, sample (B) is significantly higher than all the other samples (D, E, C, and A), respectively.

The results indicate that, for the samples (A, C, and E), there are not significant differences in mold between the winter and spring seasons. However, the findings indicate that samples B and D's mean mold values in the spring are significantly higher than their corresponding mean values in the winter. In conclusion, fungal growth is significantly influenced by the season (Moh, 2017).

The results also showed that all the samples have mold count mean less than the maximum Palestinian standard (PS 18-2-2019) where the total number of mold should not exceed 10 cfu/ml, which is equivalent to 1 log cfu/ml during the storage time in winter and in spring except the samples (D & B), whose mold mean values are higher than the standards.

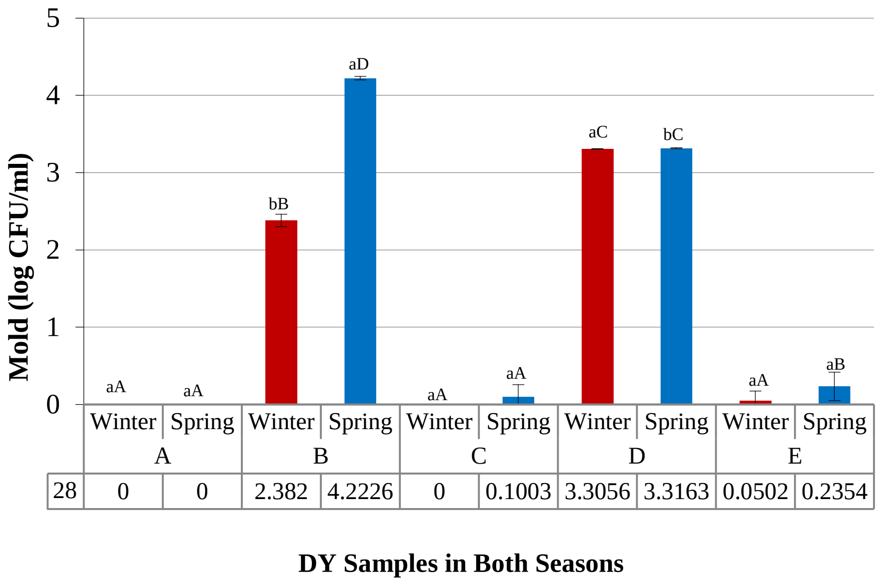


Fig. (4.14): The results of mold (log CFU/ml) for samples at day 28 in both seasons for each sample. Comparison of differences between companies in a single season are shown by different capital superscript characters. Seasonal changes within a single sample are indicated by different lowercase superscript characters.

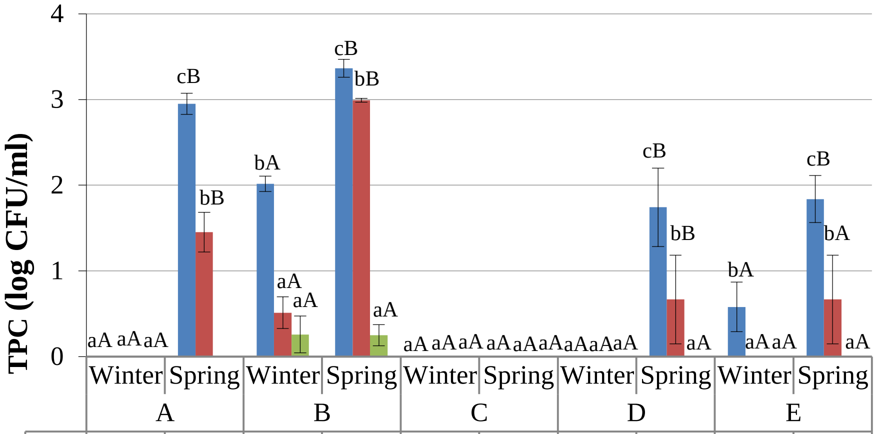
Overall, the results suggest that mold growth in DY were heavily influenced by seasonal factors, with higher temperatures and humidity in spring fostering greater mold proliferation (Büchl and Seiler, 2011). The varying effectiveness of mold control across companies highlights differences in product formulation, packaging, and storage conditions, with some companies employing more effective strategies to inhibit mold growth. Such as using GMP, sanitation, HACCP (Pal, 2014), and establishing supervisory bodies for production processes and educating and training staff (Moh, 2017).

4.5.1.3 Total Bacterial Count Analysis:

i. Seasonal influence of TPC between companies during the shelf life:

The total bacterial count in drinkable yogurt samples from five companies (A-E) was measured over 28 days during winter and spring, revealing clear seasonal and temporal trends. Initially, at day 0, the bacterial counts were relatively high for Brand B, in both seasons Fig. (4.15), suggesting either a higher initial bacterial load or optimal growth conditions at cooler temperatures. Meanwhile the other brand samples TPC in spring had highest values compared to winter.

TPC growth in DY samples from five firms (A-E) during a 28-day period in the winter and spring shows notable seasonal and temporal changes. As illustrated in Figure 4.15, samples A through E exhibited distinct TPC growth patterns throughout the 28 days, with differences influenced by seasonal conditions.



	A Winter	A Spring	B Winter	B Spring	C Winter	C Spring	D Winter	D Spring	E Winter	E Spring
0	0	2.9498	2.0164	3.3661	0	0	0	1.7425	0.5795	1.8389
14	0	1.4537	0.5132	2.9922	0	0	0	0.6667	0	0.6667
28	0	0	0.2594	0.2509	0	0	0	0	0	0

DY Samples in Both Seasons

Fig. (4.15): The results of TPC (log CFU/ml) samples according to the test days and seasons for each sample. Seasonal changes within a single day are shown by different capital superscript characters. Variations within the same season are indicated by different lowercase superscript characters.

Sample (A) showed that, there were no variations in TPC at winter days (0, 14, 28) since On all days there was an absence of TPC growth. Additionally, in the spring, the TPC decreases significantly over time. A comparative analysis revealed that TPC levels on days 0 and 14 in winter were significantly lower than in spring. However, no significant differences in TPC were observed between winter and spring on day 28. This suggests that the bacterial population has plummeted into their death phase because the bacterial growth is significantly impacted by the pH dropping and the acidity development over the product's shelf life, which is a key component in halting growth and getting to this phase as a result of environmental factors, the presence of bacteriostatic agents.

As for sample (B), there are notable changes between the days (0, 14, 28) in both seasons, as the TPC decreases significantly over time in both seasons. Additionally, the results of days 0 and 14 in winter were significantly lower than those in spring. However, no significant differences in TPC were observed between winter and spring on day 28. This pattern implies that bacterial growth was fast at first but slowed down during the death phase, as a result of competitive inhibition, nutrient depletion or other factors (Hamad, 2012). The low bacterial counts on day 28 for both seasons suggest either increase of product acidity over storage or efficient microbial control over time.

For sample (C) was an absence of TPC growth for every day and in both seasons, suggesting the use of specific types of preservatives or implementation of strict microbial control measures. An indication of successful bacterial inhibition is the steady decline in bacterial load over time.

Total Plate Count (TPC) values for Sample D was an absence growth on winter days 0, 14, and 28, indicating no bacterial growth during this season. However, the TPC for product (D) decreased dramatically over time in the spring. Spring TPC measurements were regularly greater than those in the winter, and the discrepancies are most obvious on days 0 and 14, which are significantly lower in winter. Bacterial numbers are steadily decreasing. On day 28 of both seasons, there was an absence of TPC growth, with no difference between the winter and spring seasons. The fluctuation between seasons may be attributed to differences in storage conditions or formulation, impacting bacterial survival and sanitary conditions during heat treatment, processing, packaging, and storage. It is worth mentioning that Company D had the worst results in terms of fungal growth in general, the highest acidity, and the lowest pH, all of which have an effect on bacterial development, as well as the presence of competing starters, which may restrict the growth of other bacteria.

Sample (E) results, TPC declined significantly from day 0 to day 28 in both seasons. Spring readings were generally higher than those in winter on days 0 and 14, though, the data showed that there are no significant variations between winter and spring, with the average TPC values in both seasons were an absence of TPC growth on day 28. In spring, sample E exhibited similar patterns to sample D, beginning with moderate bacterial numbers and subsequently decreasing. The decreased counts over the winter months suggest that cold temperatures or specific yogurt additions may inhibit bacterial development.

The decline in TPC over the product's shelf-life contrasts with findings by Matin et al., (2018) on yogurt samples, Araki and Kokoner (2003) on flavored yogurt, and Ozai et al., (2020) with regard to Ayran. However, the results were in agreement with Moh (2017), who confirmed the increase in TPC in the dry season compared to the rainy season.

Overall, the prevalence of these bacteria is critical to the industry's ability to produce high-quality, healthful dairy products. Protein activity has been proven to have a relatively strong relationship with TPC and hence may be a better predictor of milk quality (Markusson, 2021). Bacterial growth could be influenced by intrinsic, extrinsic, impact, and processing elements such as pH, temperature (various seasons and storage temperature), water activity, macronutrients, oxygen levels, and so on (Hamad, 2012). Furthermore, the findings show that seasonal temperature differences influence bacterial growth in drinking yogurt, which is an efficient microbial control method.

ii. TPC influence on product at day 28 between companies during the seasons:

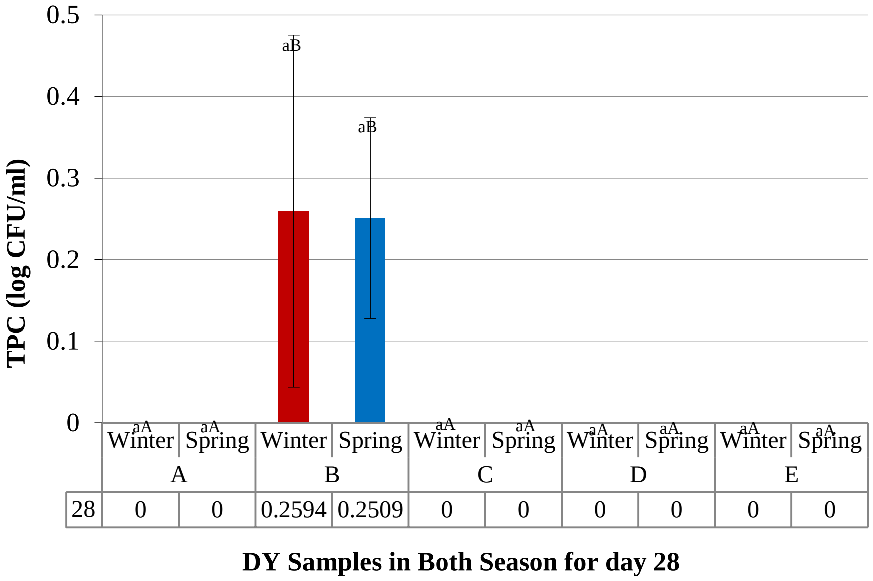


Fig. (4.16): The results of TPC (log CFU/ml) for samples at day 28 in both seasons for each sample. Comparison of differences between companies in a single season are shown by different capital superscript characters. Seasonal changes within a single sample are indicated by different lowercase superscript characters.

The results in Fig. (4.16) reveal that there are substantial differences in TPC between samples B and (A, C, D, and E) in both seasons. Sample (B) has a much higher TPC than the other samples, which all have zero values.

However, the TPC mean values for all samples are below the maximum Palestinian standard value, which is 3 log CFU/ml in However, since the two means in the winter and spring are zeros, which correspond to all samples except sample (B), the results indicate that there are no differences in TPC between the two seasons (winter and spring) for any of the samples.

The findings for sample (B) indicate that winter and spring do not significantly differ from one another. Therefore, it can be concluded that the season variable has no effect on the TPC values for any of the companies under study in both the winter and spring. This is inconsistent with Moh (2017), who validated the effect of the season on TPC Growth.

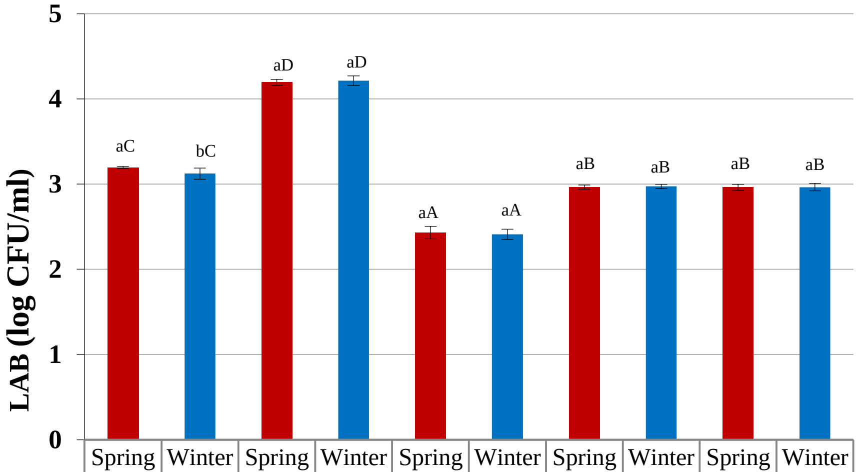
4.5.2 Micro-Biota: Lactic acid starter cultures bacteria influence on drinking yogurt at 1st day between companies during the seasons:

The results presented in Fig. 4.17 indicate significant differences (**P** < 0.05) in lactic acid bacteria (LAB) count in samples A, B, C, D, and E on the first day in both winter and spring. Sample B showed the maximum followed by Samples A, D, E and C, respectively, with no statistically significant difference between samples D and E. Across all samples, no significant seasonal differences in LAB (lactic acid bacteria) counts were observed, suggesting that seasonal variation does not substantially affect LAB levels. This implies that every manufacturer uses the same starter culture in their recipes throughout the year, in terms of concentration, type, and incubation characteristics (temperature and time) (Ibrahim et al., 2019), regardless of the season.

Sample (A) exhibited significant differences in LAB between the two seasons (winter and spring), with winter LAB being significantly lower than spring LAB. In contrast, samples B, C, D, and E indicated that there is no significant seasonal distinction between different. Therefore, it can be concluded that, with the exception of sample (A), the season variable has no effect on the LAB values for any of the companies under study

The LAB mean values of all brands, regardless of the season, were below the maximum international standard value in CODEX STAN 243-2003, which is 7 log cfu/ml in the spring and winter. Multiple factors can influence starter culture growth, including the duration between pasteurization and production, the type, concentration, and incubation conditions of the starter culture used, the post-acidification of the drinking yogurt (pH and titratable acidity), additives such as stabilizers and preservatives used by each company either before or after adding the other ingredients, product packaging method, and sterilization system (Mohammadi et al., 2012).

The findings align with those of Akbulut & Bozkurt (2020), who verified that pH has an impact on starter growths' preparedness as well as their shelf life, which drops during 20 days. Ibrahim et al. (2019) additionally verified that there are notable variations in the impact of fermentation temperature and culture concentration on LAB growth. However, with the exception of Sample A, the findings of this study differ from those of Moh et al. (2021), who noted a seasonal effect on LAB .



	A		B		C		D		E	
	Spring	Winter	Spring	Winter	Spring	Winter	Spring	Winter	Spring	Winter
Total	3.1958	3.1231	4.1936	4.2145	2.4317	2.4116	2.9656	2.9741	2.9618	2.9643

DY Samples in Both Seasons

Fig. (4.17) : The results of LAB (log CFU/ml) samples according to the test day 0 in both seasons for each company. Seasonal changes within a single season are shown by different capital superscript characters. Seasonal changes within a single sample are indicated by different lowercase superscript characters.

4.6 Sensory Evaluation of Drinking Yogurt:

The study used a paper-based questionnaire distributed to 25 participants, who are experts specialized in the field of food processing and nutrition department in agriculture department at Hebron university / Hebron. The results showed that 48% are (Male), 72% of the participants belonged to age group (18-30 years).

The results are presented in a tabular format, depicting various categories and the corresponding frequencies and percentages within each category.

Table (4.6): Sample socio-demographic characteristics of sample

Item	Character	Frequency (%)
Gender	Male	48
	Female	52
Age	18-30	72
	31-40	8
	41-50	8
	>50	12
Qualification	Bachelors	76
	Postgraduate	24
Specialization	Food processing	84
	Animal Production	4
	Plant Production	8
	Engineering	4
Job	Student	68
	Officer	20
	Supervisor	4
	Manager	4
	Head of the Department	4
Year of experience	0-5	68
	06-10	4
	11-15	8
	>15	20
Year of study	1^{st} Year	4
	2^{nd} year	8
	3^{rd} year	16
	4^{th} year	32
	5^{th} year	12
	$>5^{th}$ year	28
Type of yogurt	Laban Up	76
	Laban Mukhied	20
	Other	4
Frequency (times / week)	<One Time	60
	>One Time	40

In terms of gender, there were 12 individuals in category male, accounting for 48% of the total, while category Female had 13 individuals, making up 52% of the total respondents.

Moving on to age groups, category (18-30 years) was the most dominant, with 18 individuals or 72% of the total. Categories (31-40years), (41-50years), and (>50 years) represented 8%, 8%, and 12% of the total, respectively, indicating a diverse age distribution.

Qualifications of the respondents were predominantly in category Bachelors, with 19 individuals (76% of the total), while category postgraduate had 6 individuals (24% of the total).

Within the specialization category, the majority (84%) were in category food processing, followed by category animal production at 4%, and categories plant production and Engineering at 8% and 4%, respectively.

Regarding jobs, category student accounted for 68% of the respondents, category officer represented 20%, and categories supervisor, manager, and head of department each accounted for 4% of the total.

In terms of years of experience, category (0-5years) again dominated with 68%, followed by categories (6-10years), (11-15years), and (>15years) at 4%, 8%, and 20% respectively.

The years of study were distributed across several categories, with category 4 (32%) having the highest representation, followed by category >5 (28%), category 3 (16%), category 5 (12%), category 2 (8%) and category 1 at 4%.

The type of yogurt preference, category Laban Up was the most popular, chosen by 76% of the respondents, while category Mukheid and other had 20% and 4% respectively.

Lastly, when it comes to frequency Consumption Rate / Week , there were 15 individuals in category less than one time, accounting for 60% of the total, while category more than one times/week had 10 individuals, making up 40% of the total respondents.

4.6.1 Comparison between 5 DY samples according to participant opinion

After calculating the average score given by the study participants, result reveals that sample A was the best in terms of texture, flavour, mouth feel and acceptability. Sample B score the worst in terms of flavour and mouth feel while sample B score the worst in acceptability and sample B and C are the worst in their texture.

Table (4.7): Sensory evaluation for drinking yoghurt samples from different companies at 8 C by 25 participants.

Sample	Acceptability	Texture	Flavour	Mouth feel	Total
	Mean ± S.D	Mean ± S.D	Mean ± S.D	Mean ± S.D	Score (40)
A	7.68 ± 1.01^{bE}	7.96 ± 0.92^{cD}	7.56 ± 1.5^{aE}	7.56 ± 1.576^{aD}	30.76
B	6.64 ± 1.47^{bC}	7.12 ± 1.03^{cA}	5.72 ± 1.91^{aA}	5.72 ± 1.800^{aA}	25.2
C	6.16 ± 1.99^{cA}	7.12 ± 1.18^{dA}	5.92 ± 2.19^{bB}	5.76 ± 2.32^{aA}	24.96
D	7.08 ± 2.13^{cD}	7.56 ± 1.5^{dC}	6.16 ± 2.48^{aD}	6.22 ± 2.53^{bC}	27.02
E	6.52 ± 2.04^{cB}	7.16 ± 1.38^{dB}	6.08 ± 1.96^{aC}	6.16 ± 2.11^{bB}	25.92

** Sample differences within the same sensory test are indicated by different uppercase superscript characters. Differences between the sensory tests within the same sample are indicated by different lowercase superscript letters.

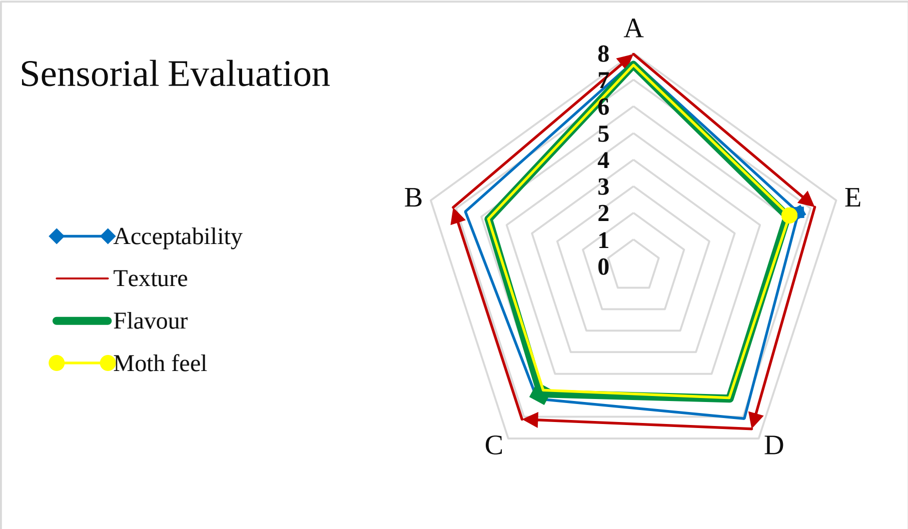


Fig. (4.18) :Sensory evaluation for drinking yoghurt samples from different companies at 8 C by 25 participants.

A sensory study of five DY samples (A-E) reveals significant variations. A clear change in sensory properties is seen in samples A through E in Figure 4.18 and table 4.6, indicating different reactions to personal preferences.

In the comprehensive analysis and comparison of the five DY samples based on the survey data, it's evident that each sample has its own unique characteristics and varying levels of appeal to the participants. Sample A emerges as the frontrunner with the highest average scores for mouthfeel, flavor, texture, and acceptability, signifying that it was the most favored among the participants. Followed by samples D, performed well. Sample E, especially in terms of flavor and acceptability. On the other hand, samples B and C received lower ratings across all aspects, indicating a less favorable perception among participants. These findings highlight the subjective nature of yogurt preferences, as participants' ratings vary significantly. The survey underscores the importance of considering various factors, including texture, taste, appearance, and overall likability, when evaluating consumer preferences in the yogurt market.

The results revealed that Company A was the best with highest overall acceptability, flavor, mouthfeel, and texture, closely followed by D. Company A had the highest levels of solids, protein, and fats Table (4.3), which have a significant impact on taste and flavor, and it was also one of the varieties with high acidity and viscosity, followed by Company D, which had the highest levels of acidity, lowest pH, and highest viscosity rate, in addition to solids, fat, protein, and high salt content, all of which have an impact on Palestinian consumer evaluation rates.

Significant differences in acceptability were observed among the samples. Company A received the highest score, followed by Companies D, B, E, and C, respectively, and this could be attributed to the type of added stabilizers, which play a significant role in influencing the taste of the product, as confirmed by Sobhay et al., (2019) in yogurt drinks and other additives that may affect the product's quality.

In terms of the acceptance, there were substantial variances, with sample A receiving the highest score, followed by Companies D, B, E, and C. This may be due to product components and the percentage of added milk, which is consistent with findings by Beşir & Mortaş (2022) in Ayran yogurt, or the type and concentration of starter cultures, which is consistent with the work of Pakbin et al., (2015) in Iranian Doogh product, or the role of pH in influencing product quality and acceptance, as explained by Akbulut & Bozkurt (2020) or the kind of additional stabilizers that have a significant impact on the taste of Ayran, as confirmed by Sobhay et al., (2019) in yogurt drinks, as well as other additives that may alter product quality.

In regard to taste and mouthfeel, the highest was sample A, then samples D, E, C, and B, respectively. This could be because of the impact of the product's acidity and pH on the perception of a salty taste, as reported by Akbulut & Bozkurt (2020) in their experiments on Ayran yogurt, or it could be because of variations in the product's milk percentage and, consequently, its solids and components, as reported by Beşir & Mortaş (2022) in Ayran yogurt, also according to Sobhay et al., (2019), the type of stabilizers used in yogurt drinks affects the product's consistency and viscosity, which in turn affects its mouth feel. Pakbin et al., (2015) explained that the type and concentration of starter cultures have a significant impact on the Doogh's flavor.

In accordance with texture and consistency, sample A was the highest, followed by D, B, C, and E, which may be due to the types of thermal treatments the product was exposed to, manufacturing processes, and additives, especially the type and concentration of primers as indicated by Pakbin et al., (2015) and the type of stabilizer used by Sobhay et al. (2019) , the impact of pH and product acidity on the perception of salty taste, as demonstrated by Akbulu & Bozkurt (2020) in their experiments on ayran yogurt and Beşir & Mortaş (2022) suggested that this could be due to variations in the product's solids and components as well as the percentage of milk.

In contrast to sample D, which showed the maximum density and viscosity, sample A is regarded as having medium rheological characteristics, no separation, and the lowest proportion of WHC%.

Chapter Five

Conclusion and Recommendations

5.1 Conclusion

This study provided an evaluation of the effect of seasonal fluctuation, company practices and shelf life of product on chosen quality criteria of commercial drinking yogurt (DY). The study led to the following conclusions:

- Regarding the product label of the DY product, all of them, with the exception of Company D, comply with item No. 7 in PS 18-2-2019 and item No. 7 in CODEX STAN 243-2003.

- With respect to the physicochemical parameters, including pH, they were in accordance with PS 18-2-2019 throughout the product's shelf life, and during the winter and spring seasons, none of the samples exceeded the maximum limit of 3.7-4.5, with the exception of Company B in the spring on the 28th and Company D in both seasons between the 14th and 28th. There is a substantial seasonal influence, as it was greater in the winter than in the spring, as well as major disparities across companies and an effect on the product's shelf life, which dropped with the passage of time during storage.

- In addition to acidity, which is one of the physiochemical properties, it was consistent with PS 18-2-2019 and CODEX STAN 243-2003 throughout the product's shelf life, and during the winter and spring, none of the samples exceeded the minimum limit of 0.6%, with the exception of Company B, which was less than 0.6%on day one. In general, the effect of the season was observed, as it was significantly lower in winter than in spring, and the effect of the shelf life on the acidity of the product showed substantial variations, increasing with the product's storage duration, with significant differences identified amongst companies.

- The chemical content of the DY product was also investigated for all companies during the winter and spring seasons, and both a seasonal influence and significant variances across companies were discovered. Moisture%, TS%, fat%, protein%, SNF%, ash, minerals (ppm), and salt content were investigated, and the following results were obtained:

  - TS % and moisture % have an inverse relationship. For both, there are significant variances between companies and a significant seasonal effect. In both seasons, solids were higher in the winter than in the spring, with Company A having the highest and Company C having the lowest. While humidity was lower in winter than in spring, Company A had the lowest rating and Company C the highest.

  - Fat content fluctuates from company to company throughout the period of two seasons, possibly due to manufacturing procedures such as standardization and recipes. During both seasons, Company A had the highest fat percentage while Company C had the lowest.

  - Protein content showed a seasonal influence, with greater levels in winter and lower levels in spring, except for Company E. Differences were also noticed between firms, with Company A having the highest in winter and Company E in spring. Companies B and C had the lowest results in both seasons.

  - The content of SNF shows a seasonal effect on each company independently. Differences were also found amongst the companies, with Company A having the highest in both seasons, Company C having the lowest in winter, and Company E having the lowest in spring.

  - In terms of ash content, there was a strong seasonal effect and considerable variances amongst enterprises. Spring was higher than winter. Company A had the highest in winter, whereas Company C had the highest in spring and the lowest in winter. Companies E and D had the lowest spring results.

  - In terms of mineral composition, there was a strong seasonal effect and large variances amongst enterprises. Spring was higher than winter. In terms of sodium, it was discovered that Company C and E had the greatest levels while Company D had the lowest in winter, whereas Company B had the highest and Companies C and D had the lowest in spring. In the amount of potassium, Company C had the most in both seasons, whereas Company A had the lowest in winter and Company E had the lowest in the spring. In regards to calcium, Company E had the highest and Company A had the lowest levels in winter, while Company C had the highest and Company D the lowest levels in spring. In terms of magnesium, Company C had the highest levels in both seasons, whereas Company A had the lowest in the winter and Company D the lowest in the spring.

  - In terms of salt content, there is no significant seasonal influence, but there is a company effect, as substantial variances were found, with Company B having the highest salt concentration in winter and Company E in spring, and Company C having the lowest salt level in both seasons. However, there is no discernible seasonal effect on salt content. It's worth noting that they were all less than one percent.

- Since preservatives, particularly sorbates, are added in varying amounts from season to season and from company to company, we observed noticeable variations in the two seasons for the majority of companies. Company D and C had the lowest and were regarded as minor quantities (i.e., not used) in both seasons, while Company A had the greatest in the winter and Company E in the spring. In addition, companies B and A showed that sorbates were either not used at all or used only rarely in the spring. It is important to note that PS No. 18-2-2019 forbids the use of sorbates in drinkable yogurt.

- In accordance with rheological parameters, including viscosity, there is an influence on the product throughout its shelf life, as well as a significant seasonal effect and significant differences between companies. It appeared that it is much higher in the winter than in the spring and that the viscosity of the product increases with the passage of days throughout its storage period. It was also discovered that Company D was the highest in the winter, Company C was the highest in the spring, and Company B was the lowest during both seasons.

- With respect to the degree of product serum separation and water holding capacity according to rheological parameters, there is a considerable seasonal effect as well as major differences between companies. The product serum separation was lower in winter than in spring. It was also discovered that Company B was the highest in winter, Company D was the highest in spring, and Companies A and C were the lowest in both seasons. Since the water-holding capacity was inversely correlated with the serum separation, it was higher in the winter than in the spring. In both seasons, Company A was the lowest and Company B was the highest.

- In respect to product density based on rheological parameters, there is a noticeable seasonal effect and significant variances between enterprises. The product's density was lower in winter than in the spring. Company D was found to be the highest, while Company E was the lowest in both seasons.

- Microbiological tests showed that maintaining sanitary conditions is crucial for maintaining product quality throughout time.

- Coliform and fecal were not detected on all DY samples in both seasons, and during storage period from different companies which reflects adequate hygienic conditions during product processing.

- Yeasts, which are one of the microbial criteria for pathogen and spoilage, the effect of season and shelf life on the quality of the product was observed, with significant differences between companies, and the majority of the samples were in accordance with PS 18-2-2019 and CODEX STAN 243-2003. Throughout the product's shelf life and during the winter and spring seasons, none of the samples exceeded the upper limit of log 2 CFU/ml, with the exception of Company B on day 28 and Company D on days 14 and 28. Compared to winter, it was significantly higher in the spring. While companies A and C did not exhibit any growth in either season, company D was highest in both.

- Mold, which is one of the most important microbial qualities for spoilage and pathogenicity, the effect of season and shelf life on the quality of the product was observed, with significant differences between companies, and several of the samples were in accordance with PS 18-2-2019 and CODEX STAN 243-2003 throughout the shelf life of the product, and during the winter and spring seasons, except for Company B on day 28 in winter and on days 14 and 28 in spring, and Company D on days 14 and 28 in both seasons. In the spring was significantly higher than in the winter. In the winter, Company D was the highest, whereas in the spring, Company B was the highest. Yeast growth was not observed in Companies A and C during the shelf life or throughout either season.

- Regarding TPC, one of the crucial microbiological standards for product quality, the impact of season and shelf life on the product's quality was noted, with notable variations throughout firms. In the spring, TPC was much greater than in the winter. Company C was the lowest, and Company B was the highest in both seasons.

  - Regarding the LAB culture, an essential parameter of useful microbiota in microbiological parameters, it was shown that the season had no effect and that there were notable variations throughout companies, with the company operator choosing the concentration and quantity. Company C was the lowest, and Company B was the top in both seasons. CODEX STAN 243-2003, which established a minimum limit of 10^7 CFU/ml, was not met by any of them. This could be because days have passed since the actual date of fermentation.

  - In the sensory evaluation, there were evident disparities between companies based on consumer desire, with Company A scoring the highest and best in terms of sensory evaluation items. Company C had the lowest overall acceptance rate, and Company B had the lowest flavor, texture, and mouthfeel rating.

  - A drinking yogurt product's high nutritional content of fats, proteins, salts, minerals, and good bacteria, along with its percentage of water and the absence of sorbates, result in it being fairly nutritious in some companies. Some companies produced DY products that were safe for human consumption because they are free of contaminants, pathogens, and spoilage all year long.

5.2 Recommendations

- It is recommended that companies and manufacturers adhere to the documented information on the label so that it corresponds to the actual contents of the product and that the production labeling meets the requirements of the specifications and standards because it affects consumer trust and regulatory compliance.

- To get the best and most accurate results, more research is required to examine each of the product quality parameters (physicochemical, rheological, microbiological, and sensory) independently.

- More research is needed to determine the influence of the remaining seasons of the year on the drinking yogurt.

- Further study is needed to determine the influence of product storage temperature during the product's shelf life on the drinking yogurt.

- It is urged to discontinue the use of sorbates and other preservatives and commit to producing a product that meets the necessary Palestinian and international technical specifications.

- Food companies and factories should control health conditions and follow Hazard Analysis Control Point (HACCP), Good Manufacturing Practices (GMP), sanitation, and dairy product preservation during transportation, storage, and consumption to avoid economic losses in dairy establishments.

- It is proposed that official and regulatory organizations tighten control over food industries to guarantee that Palestinian products meet all Palestinian and international specifications, including requirements, conditions, and directions.

- It is advised that a study be conducted on the quality requirements and parameters of additional food items in order to broaden the scope of research studies.

- Additional research is needed to determine the chemical content of the drinking yogurt.

- More research is needed to determine the finest formula with the best components for a yogurt drink that caters to the tastes of Palestinian consumers.

- It is recommended to compare the local commercial DY product to traditional buttermilk "*Mukheid*" and to undertake research on the seasonal traditional buttermilk "*Mukheid"* product.

- Research and development of the nutritious probiotic yogurt drink product are advised.

- It is advised that consumers select premium goods produced by reputable domestic and local companies.

References

- Additives, F.(1995). CODEX GENERAL STANDARD FOR CONTAMINANTS AND TOXINS IN FOOD AND FEED (CODEX STAN 193-1995) 1. PREAMBLE 1.1 SCOPE.

- Akbulut, Ç., & Bozkurt, A. (2020). Impact of pH on the salty taste perception of the yogurt drink, ayran. *Harran Tarım ve Gıda Bilimleri Dergisi*, *24*(3), 301-309.

- Akan, S., & Bayram, M. (2021). The importance of water composition on some characteristics of food products. In *Proceedings of the CIEA II. International conference on innovative engineering applications, Muş Alpaslan University, Muş Türkiye. May 20–22* (pp. 320–324). CIEA.

- Akcay, F., Besir, A., & Yazici, F. (2020). Effect of cayenne pepper addition on physicochemical, microbiological and sensory properties of drinkable yoghurt-ayran. *Acta Universitatis Cibiniensis. Series E: Food Technology*, *24*(1), 79-87.

- Aladjadjiyan, A., Zheleva, I., & Kartalska, Y. (2016). Traditional Bulgarian dairy food. *Traditional Foods: General and Consumer Aspects*, 115-122.

- Aldaw Ibrahim, I., Naufalin, R., Erminawati, & Dwiyanti, H. (2019, December). Effect of fermentation temperature and culture concentration on microbial and physicochemical properties of cow and goat milk yogurt. In *IOP conference series: Earth and Environmental Science* (Vol. 406, No. 1, p. 012009). IOP Publishing.

- Alegbeleye, O. O., Singleton, I., & Sant'Ana, A. S. (2018). Sources and contamination routes of microbial pathogens to fresh produce during field cultivation: A review. *Food microbiology*, *73*, 177-208.

- Allgeyer, L. C., Miller, M. J., & Lee, S. Y. (2010). Sensory and microbiological quality of yogurt drinks with prebiotics and probiotics. *Journal of dairy science*, *93*(10), 4471-4479.

- Alimentarius, C. (2003). Codex standard for fermented milks (CODEX STAN 243-2003). *Adopted in*, 1-11.

- Altay, F., Karbancıoglu-Güler, F., Daskaya-Dikmen, C., & Heperkan, D. (2013). A review on traditional Turkish fermented non-alcoholic beverages: Microbiota, fermentation process and quality characteristics. *International journal of food microbiology*, *167*(1), 44-56.

- Amirpour, M., Arman, A., Yolmeh, A., Akbari Azam, M., & Moradi-Khatoonabadi, Z. (2015). Sodium benzoate and potassium sorbate preservatives in food stuffs in Iran. *Food Additives & Contaminants: Part B*, *8*(2), 142-148.

- AOAC 947.05 (2005) Official method 947.05 acidity of milk. Titrimetric method in 947.05: Official methods of analysis of AOAC international

- AOAC International (2023) Official methods of analysis, 22nd edn. (online). AOAC International, Rockville, MD

- Aryana, K. J., & Olson, D. W. (2017). A 100-Year Review: Yogurt and other cultured dairy products. *Journal of dairy science*, *100*(12), 9987-10013.

- Azene, D., Fentahun, T., & Admassu, B. (2015). Study on the Major Defects That Causes Sheep and Goat Skins Rejection in Bahir Dar Tanning Industry, Ethiopia. *Academic Journal of Animal Diseases*, 4(3), 170-176.

- Ballew, C., Kuester, S., & Gillespie, C. (2000). Beverage choices affect adequacy of children's nutrient intakes. *Archives of pediatrics & adolescent medicine*, *154*(11), 1148-1152.

- Balthazar, C. F., Pimentel, T. C., Ferrão, L. L., Almada, C. N., Santillo, A., Albenzio, M., ... & Cruz, A. G. (2017). Sheep milk: Physicochemical characteristics and relevance for functional food development. *Comprehensive reviews in food science and food safety*, *16*(2), 247-262.

- Bansal, B., Habib, B., Rebmann, H., & Chen, X. D. (2009, June). Effect of seasonal variation in milk composition on dairy fouling. In *Proceedings of the International Conference on Heat Exchanger Fouling and Cleaning VIII, Schladming, Austria* (Vol. 19, pp. 369-388).

  Barłowska, J., Szwajkowska, M., Litwińczuk, Z., & Król, J. (2011). Nutritional value and technological suitability of milk from various animal species used for dairy production. *Comprehensive reviews in food science and food safety*, *10*(6), 291-302.

- Béal, C., & Helinck, S. (2014). Yogurt and other fermented milks. *Microorganisms and fermentation of traditional foods, 141.*

- Beşir, A., & Mortaş, M. (2022). Investigation properties of Ayran (yoghurt drink) produced from different ratio of cow and hemp seed milk mixtures. *European Food Science and Engineering*, *3*(1), 5-10.

- Bintsis, T., & Papademas, P. (2022). The evolution of fermented milks, from artisanal to industrial products: A critical review. *Fermentation*, *8*(12), 679.

- Bird, E. W., Weber, J., Cox, C. P., & Chen, T. C. (1961). Determination of calcium and magnesium in milk by EDTA titration. *Journal of Dairy Science*, *44*(6), 1036-1046.

- Bowser, T. (2012). *Water use in the food industry*. Oklahoma Cooperative Extension Service.

- BS, B. S. (1989). Determination of fat content of milk and milk products (Gerber method)—. *Methods for chemical analysis of liquid milk and cream. BSI bulletin no 1741*.

- Büchl, N. R., & Seiler, H. (2011). Yeast and Molds/Yeasts in Milk and Dairy Products. In *Encyclopedia of dairy sciences*. Elsevier.

- Bylund, G. (2003). *Dairy Processing Handbook*, Second rev. edition. Tetra Pak Processing Systems AB, Lund, Sweden.

- Çakır, Ç. A., & Bozkurt, A. (2020). Impact of pH on the salty taste perception of the yogurt drink, ayran.

- Chandan, R. C. (2006). Milk Composition, Physical and Processing Characteristics.

- *Manufacturing yogurt and fermented milks*, 17-40.

- Chandan, R. C. (2011). Dairy ingredients for food processing: an overview. *Dairy ingredients for food processing*, 3-33.

- Chandan, R. C., Gandhi, A., & Shah, N. P. (2017). Yogurt: Historical background, health benefits, and global trade. In *Yogurt in health and disease prevention* (pp. 3-29). Academic Press.

- Chen, Chen, Shanshan Zhao, Guangfei Hao, Haiyan Yu, Huaixiang Tian, and Guozhong Zhao. (2017). Role of lactic acid bacteria on the yogurt flavour: A review. *International journal of food properties* 20, no. sup1: S316-S330.

- Collentro, W. V. (2021). Validation of Pharmaceutical Water Systems. In *Handbook of Validation in Pharmaceutical Processes, Fourth Edition* (pp. 89-137). CRC Press.

- Cruijsen, H., Poitevin, E., & Brunelle, S. L. (2019). Determination of minerals and trace elements in milk, milk products, infant formula, and adult nutrition:

Collaborative study 2011.14 method modification. *Journal of AOAC International*, *102*(6), 1845-1863.

- Dehghan, P., Mohammadi, A., Mohammadzadeh-Aghdash, H., & Dolatabadi, J. E. N. (2018). Pharmacokinetic and toxicological aspects of potassium sorbate food additive and its constituents. *Trends in Food Science & Technology*, *80*, 123-130.

- Descamps, O., Langevin, P., & Combs, D. H. (1986). Physical effect of starch/carrageenan interactions in water and milk.

- Deshwal, G. K., Tiwari, S., Kumar, A., Raman, R. K., & Kadyan, S. (2021). Review on factors affecting and control of post-acidification in yoghurt and related products. *Trends in food science & technology*, *109*, 499-512.

- Du, C., Li, B., & Yu, W. (2021). Indoor mould exposure: characteristics, influences and corresponding associations with built environment—a review. *Journal of Building Engineering*, 35, 101983.

- Eder, R. (2003). Drinkable yogurt beats the bagel. Drug Store News, 25, 42-48.[6] Mortazavian, AM and Sohrabvandi, S. 1385. A Review on probiotics and probiotic food products (dairy products). Tehran.

- EFSA Panel on Food Additives and Flavourings (FAF), Younes, M., Aquilina, G., Castle, L., Engel, K. H., Fowler, P., ... & Waalkens‐Berendsen, I. (2019). Opinion on the follow‐up of the re‐evaluation of sorbic acid (E200) and potassium sorbate (E202) as food additives. *EFSA Journal*, *17*(3), e05625.

- Esfandiari, Z., Badiey, M., Mahmoodian, P., Sarhangpour, R., Yazdani, E., & Mirlohi, M. (2013). Simultaneous determination of sodium benzoate, potassium sorbate and natamycin content in Iranian yoghurt drink (Doogh) and the associated risk of their intake through Doogh consumption. *Iranian journal of public health*, *42*(8), 915.

- Esfandiari, Z., Saraji, M., Madani, R. A., & Jahanmard, E. (2016). Status of benzoic acid amount during processing from yoghurt to its by-product drink (Doogh). *Italian journal of food science*, *28*(3), 536.

- Erkaya, T., Başlar, M., Şengül, M., & Ertugay, M. F. (2015). Effect of thermosonication on physicochemical, microbiological and sensorial characteristics of ayran during storage. *Ultrasonics Sonochemistry*, *23*, 406-412.

- Everett, D. W., & McLeod, R. E. (2005). Interactions of polysaccharide stabilisers with casein aggregates in stirred skim-milk yoghurt. *International Dairy Journal*, *15*(11), 1175-1183.

- FAO/WHO (2001). Health and nutritional properties of probiotics in food including powder milk with liver lactic acid bacteria. Food and Agriculture Organization and World Health Organization Joint report, 34.

- FAO. (2015). FAOSTAT: Statistics division. food and agriculture organization of the United Nations 2010. Available from: http://faostat.fao.org/. Accessed 2015 July 31.

- Ferreira, I. M., Mendes, E., Brito, P., & Ferreira, M. A. (2000). Simultaneous determination of benzoic and sorbic acids in quince jam by HPLC. *Food research international*, *33*(2), 113-117.

- Fisberg, M., & Machado, R. (2015). History of yogurt and current patterns of consumption. *Nutrition reviews*, *73*(suppl_1), 4-7.

- Hachana, Y., Rejeb, R., Chiboub, N., & Zneidi, I. A. (2017). Variation factors of yoghurt quality during the manufacturing process.

- Hakimi, S., Zahraee, S. M., & Mohd Rohani, J. (2018). Application of Six Sigma DMAIC methodology in plain yogurt production process. *International Journal of Lean Six Sigma*, *9*(4), 562-578.

- Hamad, S. H. (2012). Factors affecting the growth of microorganisms in food. *Progress in food preservation*, 405-427.

- Hassan, A. N., Frank, J. F., Farmer, M. A., Schmidt, K. A., & Shalabi, S. I. (1995). Observation of encapsulated lactic acid bacteria using confocal scanning laser microscopy. *Journal of Dairy Science*, *78*(12), 2624-2628.

- Hoadley, J. E., & Rowlands, J. C. (2008). FDA perspectives on food label claims in the USA. In *Nutraceutical and Functional Food Regulations in the United States and Around the World* (pp. 113-132). Academic Press.

- Hossain, D., Harun, A. B., Ahmed, M. J., Al Bayazid, A., Bristi, S. Z. T., Karim, M. R., ... & Uddin, N. (2024). Microorganisms in the Dairy Industry. In *Microbial Products for Health and Nutrition* (pp. 391-462). Singapore: Springer Nature Singapore.

- Hotel, A. C. P., & Cordoba, A. (2001). Health and nutritional properties of probiotics in food including powder milk with live lactic acid bacteria. *Prevention*, *5*(1), 1-10.

- [ISIRI] Iranian National Standard. (2008) Iran: Iranian national standard No. 2453: Doogh – Specifications and test method [Internet]. 2nd ed. [cited 2008 Jul 21]. Available from: http:// www.isiri.org/portal/files/std/2453.pdf

- Jakubowska, M., & Karamucki, T. (2019). The effect of storage time and temperature on the quality of natural yoghurt. *Acta Scientiarum Polonorum. Zootechnica*, *18*(4).

- Javanmardi, F., Nemati, M., Ansarin, M., & Arefhosseini, S. R. (2015). Benzoic and sorbic acid in soft drink, milk, ketchup sauce and bread by dispersive liquid–liquid microextraction coupled with HPLC. *Food Additives & Contaminants: Part B*, *8*(1), 32-39.

- Jenness, R. (1953).Titration of Calcium and Magnesium in Milk with EDTA. Anal. Chem., 25: 966.

- Kabak, B., & Dobson, A. D. (2011). An introduction to the traditional fermented foods and beverages of Turkey. *Critical reviews in food science and nutrition, 51*(3), 248-260.

- Kabil, O. I., Ali, M. A., Ibrahim, E., & El Barbary, H. A. (2015). Effect of seasonal variation on chemical composition of Cow's milk. *Benha veterinary medical journal*, *28*(1), 150-154.

- Kang, S. S., Kim, M. K., & Kim, Y. J. (2019). Comprehensive evaluation of microbiological and physicochemical properties of commercial drinking yogurts in Korea. *Food science of animal resources*, *39*(5), 820.

- Kasaai, M. R. (2014). Use of water properties in food technology: A global view. *International Journal of Food Properties*, *17*(5), 1034-1054.

- Khan, U. M., Latif, A., & Aadil, R. M. (2024). Labneh, Ayran, Amasi, and Tarag. In Dairy Foods Processing (pp. 215-255). New York, NY: Springer US.
-
- Kiani, H. (2008). Rheological Properties of Iranian Yoghurt Drink, Doogh Hossein Kiani, Seyed Mohammad Ali Mousavi and Zahra Emam-Djomeh Department of Food Science, Technology and Engineering, Faculty of Biosystem Engineering, University of Tehran, Iran. *International Journal of Dairy Science*, *3*(2), 71-78.

- Kleyn, D. H., Lynch, J. M., Barbano, D. M., Bloom, M. J., Mitchell, M. W., & Collaborators: Cooper LS Cusak E Fick M Hanks T Hesen MK Johnson J Kleyn DH Mercer F Monahan D Peat B Petit M. (2001). Determination of fat in raw and processed milks by the Gerber method: collaborative study. *Journal of AOAC international*, *84*(5), 1499-1508

- Koçak, C., Avşar, Y. K., & Tamuçay, B. (2006). A comparative study on the production methods of ayran.

- Kocak C., Avsar, Y.K., (2009). Ayran: Microbiology and Technology. In: Yildiz, F. (Ed.), Development and Manufacture of Yogurt and Functional Dairy Products. CRC Press, Boca Raton, U.S., 123–141.

- Köksoy, A., & Kılıç, M. (2003). Effects of water and salt level on rheological properties of ayran, a Turkish yoghurt drink. *International Dairy Journal*, *13*(10), 835-839.

- Koksoy, A., & Kilic, M. (2004). Use of hydrocolloids in textural stabilization of a yoghurt drink, ayran. *Food hydrocolloids*, *18*(4), 593-600.

- Kosikowski, F. V. (1977). Cheese and fermented milk foods.

- Korkmaz, D. (2001). Precipitation titration:"determination of chloride by the Mohr method". *Methods*, *2*(4), 1-6.

- Küçükçetin, A., Şık, B., & Demir, M. (2008). Determination of sodium benzoate, potassium sorbate, nitrate and nitrite in some commercial dairy products. *Gıda*, *33*(4), 159-164.

- Leatherhead Food International (2006). Health-related and functional foods show year-on-year growth. Food News 40(2).

- Lee, W. J., & Lucey, J. A. (2010). Formation and physical properties of yogurt. *Asian-Australasian journal of animal sciences*, *23*(9), 1127-1136.

- Li, S., Ye, A., & Singh, H. (2021). Effects of seasonal variations on the quality of set yogurt, stirred yogurt, and Greek-style yogurt. *Journal of Dairy Science*, *104*(2), 1424-1432.

- Liewen, M. B., & Marth, E. H. (1985). Growth and inhibition of microorganisms in the presence of sorbic acid: a review. *Journal of Food Protection*, *48*(4), 364-375.

- Mahmoudi, R., Norian, R., Pajohi-Alamoti, M. R., & Aliakbarlu, J. (2013). Effect of season on microbial and chemical characteristics of milk and yoghurt from sheep. *Animal Production Science*, *54*(8), 1091-1094.

- Macit, E., & Bakirci, I. (2017). Effect of different stablizers on quality characteristics of the set-type yogurt. *African Journal of Biotechnology*, *16*(46), 2142-2151.

- Markusson, H. (2021). Total bacterial count as an attribute for raw milk quality.

- Marshall, M. R. (2010). Ash analysis. *Food analysis*, *4*, 105-116.

- Matin, A., Banik, T., Badsha, M. R., Hossain, A., Haque, M. M., & Ahmad, M. (2018). Microbiological quality analysis of yoghurt in some selected areas of Bangladesh. *International Journal of Natural and Social Sciences*, *5*(4), 82-86.

- Mckinley, M. C. (2005). The nutrition and health benefits of yoghurt. *International journal of dairy technology*, *58*(1), 1-12.

- Mefleh, M., Darwish, A. M. G., Mudgil, P., Maqsood, S., & Boukid, F. (2022). Traditional fermented dairy products in southern Mediterranean countries: from tradition to innovation. *Fermentation*, *8*(12), 743.

- Moh, L. G., Keilah, L. P., Etienne, P. T., & Jules-Roger, K. (2017). Seasonal microbial conditions of locally made yoghurt (shalom) marketed in some regions of Cameroon. *International Journal of Food Science*, *2017*(1), 5839278.

- Moh, L. G., Etienne, P. T., & Jules-Roger, K. (2021). Seasonal diversity of lactic acid bacteria in artisanal yoghurt and their antibiotic susceptibility pattern. *International Journal of Food Science*, *2021*(1), 6674644.

- Mohammadi, R., Sohrabvandi, S., & Mohammad Mortazavian, A. (2012). The starter culture characteristics of probiotic microorganisms in fermented milks. *Engineering in Life Sciences*, *12*(4), 399-409.

- Mota, F. J., Ferreira, I. M., Cunha, S. C., Beatriz, M., & Oliveira, P. P. (2003). Optimisation of extraction procedures for analysis of benzoic and sorbic acids in foodstuffs. *Food Chemistry, 82*(3), 469-473.

- Motawee, M. M., & Neveen, S. M. (2016). Effect of starter culture as a source of microbial contamination on the quality and safety of yogurt in Giza, Egypt. *International Journal of Food Science and Nutrition Engineering*, *6*(5), 103-111.

- Noor, N., Shah, A., Gani, A., Gani, A., Jhan, F., ul Ashraf, Z., ... & Ganaie, T. A. (2021). Pectin. *Food biopolymers: Structural, functional and nutraceutical properties*, 127-171.

- Ozrenk, E., & Inci, S. S. (2008). The effect of seasonal variation on the composition of cow milk in Van Province. *Pakistan Journal of nutrition*, *7*(1), 161-164.

- Osmonics. (1997). Pure water handbook. Osmonics Inc., Minnetonka, MN. *Second Edition* (pp. 6-149)

- Özer, B. H., & Kirmaci, H. A. (2010). Functional milks and dairy beverages. *International Journal of Dairy Technology*, *63*(1), 1-15.

- Pakbin, B., Mahmoudi, R., & Fakhri, O. (2015). Physicochemical and Rheological Properties of Doogh Under Specific Fermentation. *The Journal of Microbiology, Biotechnology and Food Sciences*, *5*(3), 238.

- Palestinian Central Bureau of Statistics (PCBS) (2020): "Series of Economic Surveys 2018 (Unpublished Data)", Ramallah, Palestine.

- Pal, M. (2014). Spoilage of dairy products due to fungi. *Beverage and food world*, *41*(7), 37-38.

- Palestinian Standard Institution (PSI), (2019): Fermented milk products-yogurt drink Standard (PS-18-2- 2019).3^ed Edition, Palestinian standard institution, Hebron, West bank, Palestine.

- Parmar, P., Lopez-Villalobos, N., Tobin, J. T., Murphy, E., McDonagh, A., Crowley, S. V., ... & Shalloo, L. (2020). The effect of compositional changes due to seasonal variation on milk density and the determination of season-based density conversion factors for use in the dairy industry. *Foods*, *9*(8), 1004.

- Phillips, G. O., & Williams, P. A. (Eds.). (2009). *Handbook of hydrocolloids*. Elsevier.

- Pylypiw Jr, H. M., & Grether, M. T. (2000). Rapid high-performance liquid chromatography method for the analysis of sodium benzoate and potassium sorbate in foods. *Journal of chromatography A, 883*(1-2), 299-304.

- Quist, M. A., Blanc, S. J., Hand, K. J., Lazenby, D., & Rangel, A. H. N. (2008). Influência do estágio de lactação sobre a composição do leite de búfala. *Acta Vet. Brasilica*, *5*(3), 306-310.

- Ramadani, X., Kryeziu, A., Kamberi, M., & Zogaj, M. (2024). Influence of the farm location and seasonal fluctuations on the composition and properties of the milk. *Agronomy Research*, *22*(1).

- Ratnakaran, A. P. (2016). *Energy use and emission reduction in dairy farm* (Doctoral dissertation, Academy of Climate Change Education and Research Vellanikkara).

- Rațu, R. N., Cârlescu, P. M., Usturoi, M. G., Lipșa, F. D., Veleșcu, I. D., Arsenoaia, V. N., ... & Simeanu, D. (2023). Effects of Dairy Cows Management Systems on the Physicochemical and Nutritional Quality of Milk and Yogurt, in a North-Eastern Romanian Farm. *Agriculture*, *13*(7), 1295.

- Raza, I., Masood, A., Hassan, M., & Abid, S. (2020). Consumer behavior in yoghurt purchase and consumption. *Global Journal of Science Frontier Research*, *20*(5).

- Routray, W., & Mishra, H. N. (2011). Scientific and technical aspects of yogurt aroma and taste: a review. *Comprehensive Reviews in Food Science and Food Safety*, *10*(4), 208-220.

- Rybicka, I., & Nunes, M. L. (2022). Benefit and risk assessment of replacing of sodium chloride by other salt/substances in industrial seafood products. *EFSA Journal*, *20*, e200420.

- Saad, B., Bari, M. F., Saleh, M. I., Ahmad, K., & Talib, M. K. M. (2005). Simultaneous determination of preservatives (benzoic acid, sorbic acid, methylparaben and propylparaben) in foodstuffs using high-performance liquid chromatography. *Journal of Chromatography A*, *1073*(1-2), 393-397.

- Saadi, A. (2024). Use of yeasts and Moulds in the manufacture of dairy products: A Review. *International Journal of Multidisciplinary Comprehensive Research, 35*(5), 2583-5289

- Saint-Eve, A., Lévy, C., Martin, N., & Souchon, I. (2006). Influence of proteins on the perception of flavored stirred yogurts. *Journal of dairy science*, *89*(3), 922-933.

- Saleh, A., (2020,2nd Jan): To prepare rayeb: Sa'n and Saqa are daily rituals in Sinai life. Sadaalbalad

- Salaün, F., Mietton, B., & Gaucheron, F. (2005). Buffering capacity of dairy products. *International Dairy Journal*, 15(2), 95-109.

- Şen, E., & Küplülü, Ö. (2004). Determination of agreement to Turkish food codex of unpackaged ayran consumed in Ankara.

- Seppo, L., Jauhiainen, T., Poussa, T., & Korpela, R. (2003). A fermented milk high in bioactive peptides has a blood pressure–lowering effect in hypertensive subjects. *The American journal of clinical nutrition*, *77*(2), 326-330.

- Shoabkeh, A. (2022): Sa|'an is a present memory in the local products industry. Alghad.net. Jordan.(https://alghad.com/Section-182/1124184)

- Silva, M. M., & Lidon, F. C. (2016). Food preservatives-An overview on applications and side effects. *Emirates Journal of Food and Agriculture*, *28*(6), 366.

- Sobhay, A., Hassan, Z. M. R., & El-Batawy, O. I. (2019). Properties of drinking yoghurt using different types of stabilizers. *Arab Universities Journal of Agricultural Sciences*, *27*(1), 431-440.

- Sodini, I., Remeuf, F., Haddad, S., & Corrieu, G. (2004). The relative effect of milk base, starter, and process on yogurt texture: a review. *Critical reviews in food science and nutrition*, *44*(2), 113-137.

- Stanojevic, D., Comic, L. J., Stefanovic, O., & Solujic-Sukdolak, S. (2009). Antimicrobial effects of sodium benzoate, sodium nitrite and potassium sorbate and their synergistic action in vitro. *Bulgarian Journal of Agricultural Science*, *15*(4), 307-311.

- Tarakçı, Z., & Küçüköner, E. (2003). Physical, chemical, microbiological and sensory characteristics of some fruit-flavored yoghurt. *Yüzüncü Yıl Üniversitesi Veteriner Fakültesi Dergisi*, *14*(2), 10-14.

- Tasneem, M., Siddique, F., Ahmad, A., & Farooq, U. (2014). Stabilizers: Indispensable substances in dairy products of high rheology. *Critical reviews in food science and nutrition*, *54*(7), 869-879.

- Tfouni, S. A. V., & Toledo, M. C. F. (2002). Determination of benzoic and sorbic acids in Brazilian food. *Food control*, *13*(2), 117-123.

- Thakur, B. R., Singh, R. K., & Arya, S. S. (1994). Chemistry of sorbates—a basic perspective. *Food Reviews International*, *10*(1), 71-91.

- The Palestinian Information center, (2018): "Dairy has the largest share in the Palestinian market". Palestine. (https://palinfo.com/news/2018/11/24/132299, 22.06.2023)

- Thompson, J. L., Lopetcharat, K., & Drake, M. A. (2007). Preferences for commercial strawberry drinkable yogurts among African American, Caucasian, and

Hispanic consumers in the United States. *Journal of dairy science*, *90*(11), 4974-4987.

- Thompson, L. J. (2018). Sodium chloride (salt). In *Veterinary Toxicology* (pp. 479-482). Academic Press.

- TSE (1982). TS 3810 standard of ayran. Ankara, Turkey: Turkish Institute of Standards.

- Uzay, M., Öztürk, H. İ., Buzrul, S., & Maskan, M. (2021). A study on rheological properties, sensory evaluation and shelf life of ayran–shalgam mixtures. *Journal of Food Science and Technology*, *58*(7), 2479-2486.

- Vedamuthu, E. R. (2013). Starter cultures for yogurt and fermented milks. *Manufacturing yogurt and fermented milks*, 115-148.

- Waldner, D. N., Stokes, S. R., Jordan, E. R., & Looper, M. L. (2007). Managing milk composition: normal sources of variation.

- Wang, Y., Wu, J., Lv, M., Shao, Z., Hungwe, M., Wang, J., ... & Geng, W. (2021). Metabolism characteristics of lactic acid bacteria and the expanding applications in food industry. *Frontiers in bioengineering and biotechnology*, 9, 612285.

- Wedzicha, B. L., & Brook, M. A. (1989). Reaction of sorbic acid with nucleophiles: preliminary studies. *Food Chemistry*, *31*(1), 29-40.

- Weerathilake, W. A. D. V., Rasika, D. M. D., Ruwanmali, J. K. U., & Munasinghe, M. A. D. D. (2014). The evolution, processing, varieties and health benefits of yogurt. *International Journal of Scientific and Research Publications*, *4*(4), 1-10.

- Widyastuti, Y., & Febrisiantosa, A. (2014). The role of lactic acid bacteria in milk fermentation. *Food and Nutrition Sciences*, *2014*.

- Worku, H., Amenu, K., & Fesseha, H. (2020). The Role of Starter Culture in Producing Probiotic Yoghurt: Significance for Human Health—A Review. *Int. J. Recent Biotechnol*, *8*, 20-34.

- Yang, T., Wu, K., Wang, F., Liang, X., Liu, Q., Li, G., & Li, Q. (2014). Effect of exopolysaccharides from lactic acid bacteria on the texture and microstructure of buffalo yoghurt. *International Dairy Journal*, *34*(2), 252-256.

- Yarramraju, S., Akurathi, V., Wolfs, K., Van Schepdael, A., Hoogmartens, J., & Adams, E. (2007). Investigation of sorbic acid volatile degradation products in pharmaceutical formulations using static headspace gas chromatography. *Journal of pharmaceutical and biomedical analysis*, *44*(2), 456-463.

- Yildiz, F. (2010). *Advances in food biochemistry*. New York:CRC press.

- Yurdakok-Dikmen, B., & Filazi, A. (2021). Nutraceuticals: the Turkish perspective. In *Nutraceuticals* (pp. 1309-1320). Academic Press.

- Zacharof, M. P., & Lovitt, R. W. (2012). Bacteriocins produced by lactic acid bacteria a review article. *Apcbee Procedia, 2,* 50-56.

- Zalán, Z., Hudáček, J., Štětina, J., Chumchalová, J., & Halász, A. (2010). Production of organic acids by Lactobacillus strains in three different media. *European Food Research and Technology*, *230*, 395-404.

- Zamani Mazdeh, F., Esmaeili Aftabdari, F., Moradi-Khatoonabadi, Z., Shaneshin, M., Torabi, P., Shams Ardekani, M. R., & Hajimahmoodi, M. (2014). Sodium benzoate and potassium sorbate preservatives in Iranian doogh. Food Additives & Contaminants: Part B, 7(2), 115-119.

تقييم تأثير التغيرات الموسمية وممارسات الشركة على معايير الجودة المختارة لمشروب اللبن التجاري

اعداد: اسراء وائل دياب أبو ميزر

اسم المشرف: د. كلود الاعمى

المشرف المشارك: د. صالح صوالحة

ملخص:

يعد مشروب اللبن المالح من منتجات الألبان المخمرة التقليدية الشائعة والمطلوبة لدى المستهلكين الفلسطينيين، ويتم تحضيره عن طريق خلط الزبادي بالماء والملح. ونظرًا لأن مشروب اللبن يحتوي على الحليب والماء وثقافات البادئ، يعتبره الكثيرون منتجًا صحيًا. نتيجة للتطورات الصناعية، أصبح الزبادي المملح منتجًا تجاريًا متاحًا بكميات كبيرة في الأسواق الفلسطينية، إلا أن جوانبه الغذائية والوظيفية لم يتم دراستها بشكل كافٍ.

تستهدف هذه الدراسة تحليل تأثير ممارسات التصنيع ومدة الصلاحية على معايير الجودة لمشروب اللبن المملح لدى خمس من أهم الشركات التجارية المحلية في مناطق مختلفة من الضفة الغربية–فلسطين (شمال، وجنوب، وشرق، ووسط فلسطين). كما تم دراسة مدى التزام هذه المنتجات بالمواصفات الفلسطينية م.ف 18–2–2019 والمواصفة العالمية (CODEX STAN 243–2003) كما تم تقييم تأثير التغيرات الموسمية في فصلي الشتاء والربيع على معايير الجودة.

في فصل الشتاء، تم الحصول على 210 عبوات من مشروب الزبادي، وفي الربيع، تم الحصول على 180 عبوة من محل الشني إكسترا. تم اختيار 6 عبوات من كل علامة تجارية عشوائيًا للتقييم الحسي وتم فحصها في فصل الشتاء فقط. في كلا الموسمين، من ضمن الكمية التي تم شرائها، تم اختيار 6 عبوات عشوائيًا للاختبارات الفيزيائية والكيميائية والرويولوجية من كل علامة تجارية، وتم تعيين هذه المجموعة كمجموعة تحكم. بالإضافة إلى ذلك، تم إخضاع 6 عبوات مختارة عشوائيًا من مشروب الزبادي من كل علامة تجارية للاختبارات الميكروبيولوجية، وتم تبريد بقية العينات عند 4 درجات مئوية. تضمنت معايير الجودة الرئيسية التي تم تقييمها الخصائص الفيزيائية والكيميائية مثل الرقم الهيدروجيني والحموضة والتركيب الكيميائي (المواد الصلبة والدهون والمواد الصلبة غير الدهنية والبروتين والرماد والمعادن، بما في ذلك محتوى الصوديوم والبوتاسيوم والكالسيوم والمغنيسيوم والملح). كما تم تقييم الخصائص الرويولوجية، بما في ذلك اللزوجة والكثافة وفصل المصل وقدرة الاحتفاظ بالماء. تم فحص المعايير الميكروبيولوجية، بما في ذلك وجود ملوثات غذائية ومسببات التلف مثل

البكتيريا القولونية والبكتيريا البرازية والخميرة والعفن وعدد البكتيريا الكلي. تم اجراء جميع الفحوصات وتقييمهم وفقًا لطرق AOAC الرسمية لتقييم تفضيلات المستهلك الفلسطيني.

أظهرت نتائج الدراسة وجود فروق ذات دلالة إحصائية ($P<0.05$) في جميع الاختبارات والمعايير المدروسة بين الفصول الموسمية. تم ملاحظة اختلافات كبيرة في الخواص الفيزيائية والكيميائية، بالإضافة إلى المعايير الريولوجية والنمو الميكروبي. ولكن لم تظهر فروق ذات دلالة إحصائية في محتوى الدهون، ونسبة الملح، ونمو بكتيريا حمض اللاكتيك، مما يرجح وجود تحكم دقيق في مستوى إضافة الملح وثقافات البادئ ومعايير دهن الحليب وكمية الماء المضافة، مع عدم وجود نمو للبكتيريا القولونية والبرازية في أي من العينات أو العلامات التجارية خلال الموسمين.

كما أظهرت الدراسة تأثير ممارسات التصنيع والاختلافات الجغرافية والعلامات التجارية على جودة المنتجات، حيث التزمت ستين بالمائة من الشركات بإنتاج منتجات تتوافق مع المعايير الفلسطينية والدولية. كما لوحظت تغييرات كبيرة ($P<0.05$) في الصفات الفيزيائية، الريولوجية، والميكروبيولوجية للمنتج خلال فترة الصلاحية عند درجة حرارة $4\pm1^{\circ}$ م. أظهرت معظم الشركات التي تم التحقيق فيها مستويات أعلى من نمو البكتيريا والخميرة والعفن.

توصي الدراسة الشركات المصنعة باتباع ممارسات التصنيع الجيدة (GMP) ونقاط التحكم في تحليل المخاطر (HACCP)ومراقبة الحالة الصحية وحفظ منتجات الألبان أثناء النقل والتخزين والاستهلاك. كما يُوصى بوقف استخدام السوربات والمواد الحافظة الأخرى، والالتزام بإنتاج منتج يتوافق مع المعايير الفنية الفلسطينية والدولية. إضافة إلى ضرورة تطابق المعلومات المسجلة على الملصق مع مكونات المنتج الفعلية.

لضمان تلبية المنتجات الفلسطينية لكافة المعايير الدولية والفلسطينية، فإن الدراسة توصي بتعزيز رقابة الجهات الحكومية على صناعة الأغذية، ودعوة لتوسيع الأبحاث المستقبلية لفحص معايير الجودة بشكل منفصل ودراسة تأثير درجة حرارة التخزين على المنتج.

APPENDIX

Appendix (1)

Deanship of Graduate Studies

Al-Quds University

Agribusiness -Food Processing

Sensory Testing Questionnaire for Commercial Drinking Yoghurt Products

Dear Ladies/gentlemen,

The study being carried out by the researcher is titled:

"Evaluation of the Effect of Seasonal Variation and Company Practices on Selected Quality Parameters of Commercial Drinking Yoghurt"

As a prerequisite for acquiring a Master's degree in Agribusiness Administration - Food Processing at Al Quds University. The researcher created the attached questionnaire to evaluate the yoghurt drink product, as completing the required data and answering correctly reflect on the validity of the study's conclusions. Please be aware that your responses will be kept strictly confidential and used exclusively for scientific research reasons.

I appreciate your cooperation ☺

Best regards,

By: Esraa Wael Diab Abu Meizer

Supervisor: Dr. Claude Elama

2023-2024

Table -1- Personal Information
Please indicate (×) which case pertains to you.

Gender	▢ Male ▢ Female
Age	▢18-30 ▢31-40 ▢41-50 ▢ > 51
Qualification	▢ diploma ▢ Bachelors ▢ Postgraduate ▢ High School
Specialization	▢ Food processing ▢ Engineering ▢Management ▢ Others:………….
Job	▢Student ▢ Officer ▢Supervisor ▢Manager ▢ Head of the Department ▢ Others:………….
Year of experience/ Year of study	▢ 0-5years ▢ 6-10years ▢11-15years ▢ >16 years

What is the product's common name for drinking yogurt? ....

What is the consumption rate of the drinking yogurt?
▢ Less than once each week ▢More than once each week

The questionnaire is intended to discover and distinguish the sensory features of the yoghurt drink. You will be given 5 samples of the commercial drinking yogurt and asked to complete out Table 2, which carries the symbols (A, B, C, D, E).

The four like aspects of drinking yogurt samples—**overall Acceptability, Texture, Flavour, and Mouth feel**—are scored on a 9-point scale (**1 = Poor , 9 = extremely like**).

Extremely like (**8-9**), Good (**6-7**), Fair (**4-5**), and Poor.(**3-2-1)**

Table -2-

Please rate each characteristic of the yoghurt drink product with (×) in the appropriate box and write your score for each feature.

Company (A) properties	**Extremely like**	**Good**	**Fair**	**Poor**	**Note**
Acceptability	▢………	▢………	▢………	▢………	
Texture	▢………	▢………	▢………	▢………	
Flavor	▢………	▢………	▢………	▢………	
Mouth feel	▢………	▢………	▢………	▢………	

Company (B) properties	Extremely like	Good	Fair	Poor	Note
Acceptability	☐………	☐………	☐………	☐………	
Texture	☐………	☐………	☐………	☐………	
Flavor	☐………	☐………	☐………	☐………	
Mouth feel	☐………	☐………	☐………	☐………	

Company (C) properties	Extremely like	Good	Fair	Poor	Note
Acceptability	☐………	☐………	☐………	☐………	
Texture	☐………	☐………	☐………	☐………	
Flavor	☐………	☐………	☐………	☐………	
Mouth feel	☐………	☐………	☐………	☐………	

Company (D) properties	Extremely like	Good	Fair	Poor	Note
Acceptability	☐………	☐………	☐………	☐………	
Texture	☐………	☐………	☐………	☐………	
Flavor	☐………	☐………	☐………	☐………	
Mouth feel	☐………	☐………	☐………	☐………	

Company (E) properties	Extremely like	Good	Fair	Poor	Note
Acceptability	☐………	☐………	☐………	☐………	
Texture	☐………	☐………	☐………	☐………	
Flavor	☐………	☐………	☐………	☐………	
Mouth feel	☐………	☐………	☐………	☐………	

Any other comments you would like to add:
Thank you for collaborating with us ☺

ملحق (2): الاستبيان بالعربية

جامعــة القـدس

عمادة الدراسات العليا

إدارة زراعة ربحية – تصنيع غذائي

التاريخ: / /

استبيان خاص بالفحوصات الحسية لِـ منتج مشروب اللبن

الاخ الفاضل/الاخت الفاضلة:

تحية طيبة وبعد,

تقوم الباحثة بإجراء دراسة بعنوان:

"Evaluation of the Effect of Seasonal Variation and Company Practices on Selected Quality Parameters of Commercial Drinking Yoghurt"

كمتطلب لنيل درجة الماجستير في ادارة اعمال الزراعة الربحية–تصنيع غذائي – جامعة القدس. قامت الباحثة بإعداد الاستبانة المرفقة بهدف تقييم منتج مشروب اللبن حيث ان استكمال الاجابة على البيانات المطلوبة والدقة في الاجابة ينعكس على صحة النتائج التي ستتوصل اليها الدراسة. علما ان اجاباتكم ستحاط بالسرية التامة وستستخدم لأغراض البحث العلمي فقط.

شكرا لحسن تعاونكم ☺

الباحثة : م. اسراء وائل أبو ميزر

المشرفة : د.كلود الأعمى

2023–2024

جدول -1- البيانات الشخصية

يرجى وضع اشارة (×) على الحالة التي تنطبق عليك/ي

الجنس : ☐ذكر ☐انثى

العمر : ☐18-30 ☐31-40 ☐ 41-50 ☐51 فاكثر

المؤهلات العملية : ☐ ثانوية عامة ☐دبلوم ☐ بكالوريس ☐ دراسات عليا

التخصص : ☐تغذية وتصنيع غذائي ☐هندسة ☐ إدارة ☐ أخرى:...........

الوظيفة : ☐طالب ☐موظف ☐ مشرف عام ☐مدير ☐رئيس عام ☐ أخرى:...........

سنوات الخبرة : ☐0-5 سنوات ☐6-10سنوات ☐11-15 سنة ☐16 فاكثر

ما الاسم الشائع لمنتج مشروب اللبن : ....

ما هو معدل استهلاكك لمنتج مشروب اللبن : ☐أقل من مرة في الأسبوع ☐أكثر من مرة في الأسبوع

الاستبيان خاص بالتعرف وتمييز الخصائص الحسية لمشروب اللبن حيث سيتم تزويدك ب5عينات من مشروب اللبن وملاحظة الاختلافات بينهم من خلال تعبئة **جدول -2 - تحمل الرموز التالية: (A,B,C,D,E)**

تصنف عينات مشروب اللبن على مقياس من **9 نقاط (1 = لا يعجبني للغاية حتى 9 = يعجبني للغاية)** لأربع سمات إعجاب **(القبول العام والقوام والنكهة والمذاق).**

يعجبني للغاية (**9-8**) ، جيد (**7-6**) ، مقبول /متوسط (**5-4**) ، سيء (**3-2-1**)

جدول -2 - يرجى وضع إشارة (×) في المربع الصحيح وذكر درجة التقييم لكل سمة بمنتج مشروب اللبن بناء على وجهة نظرك/ي :

السمات والخواص (أ)/(A)		**يعجبني للغاية**	**جيد**	**متوسط**	**سيء**	**ملاحظات**
القبول العام	**Acceptability**	☐	☐	☐	☐	
القوام	**Texture**	☐	☐	☐	☐	
النكهة والطعم	**Flavor**	☐	☐	☐	☐	
المذاق	**Mouth feel**	☐	☐	☐	☐	

السمات والخواص (ب)/(B)	**يعجبني للغاية**	**جيد**	**متوسط**	**سيء**	**ملاحظات**

القبول العام	**Acceptability**	☐	☐	☐	☐	
القوام	**Texture**	☐	☐	☐	☐	
النكهة والطعم	**Flavor**	☐	☐	☐	☐	
المذاق	**Mouth feel**	☐	☐	☐	☐	

السمات والخواص (ج)/(C)		يعجبني للغاية	جيد	متوسط	سيء	ملاحظات
القبول العام	**Acceptability**	☐	☐	☐	☐	
القوام	**Texture**	☐	☐	☐	☐	
النكهة والطعم	**Flavor**	☐	☐	☐	☐	
المذاق	**Mouth feel**	☐	☐	☐	☐	

السمات والخواص (د)/(D)		يعجبني للغاية	جيد	متوسط	سيء	ملاحظات
القبول العام	**Acceptability**	☐	☐	☐	☐	
القوام	**Texture**	☐	☐	☐	☐	
النكهة والطعم	**Flavor**	☐	☐	☐	☐	
المذاق	**Mouth feel**	☐	☐	☐	☐	

السمات والخواص (هـ)/(E)		يعجبني للغاية	جيد	متوسط	سيء	ملاحظات
القبول العام	**Acceptability**	☐	☐	☐	☐	
القوام	**Texture**	☐	☐	☐	☐	
النكهة والطعم	**Flavor**	☐	☐	☐	☐	
المذاق	**Mouth feel**	☐	☐	☐	☐	

أي ملاحظات أخرى ترغب بإضافتها :
شكرا لتعاونكم معنا☺