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Ginger infusion: Unveiling the potential of natural additives in cheese production

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Abstract
The aim of this research focused on trials' designing and examining cheese samples that had differing ginger oil extract levels for their chemical makeup and antimicrobial abilities. Analysis of the fat content showed that cheese samples ginger purified had a high percentage of fat than the standard sample, and the highest fat content was found in samples treated with the highest ginger purified. Furthermore, the ash contents proven to be dramatically different between the control and experimental samples; the type and the concentration of added extracts were evidently the ones that caused the change of the ash content. A second significant finding was that all of the ginger oil, ginger alcohol, and ginger water extracts tested reduced the growth of *Escherichia coli*, Klebsiella pneumoniae, *Staphylococcus aureus* and *Enterococcus faecalis* bacterial strains, each extract type displaying different levels of effectiveness for the different strains. Stabilization of cheese composition and its shelf life with ginger oil extract as natural food additive can also be served as the potential application in the context of this work. The effect offered by the antimicrobial activity of ginger oil extracts, which hinders the development of microbes, is not only of a qualitative nature, but it also greatly influences safety and nutritional worth of the product. Through the incorporation of rud Ginger oil extracts into cheese products, the manufacturers will be able to produce safer and more healthful cheeses that not only conform to but also complement the particular nutritional needs of consumers, particularly those with specific medical conditions or precarious health statuses.

Keywords: Cheese, ginger oil extracts, natural additives, composition, microbial quality, antimicrobial properties, food innovation, food safety, sensory attributes, shelf life

Introduction
The field of biotechnology occupies a crucial position in the present day food science by employing the knowledge of molecular biology, genetics and biochemistry to deal with the problems of the lack of effective biocides to combat pathogenic bacteria in food production. Via biotechnological methods, scientists have not only been able to discover and extract bioactive substances with microbially active properties from plants but also from many other sources such as microbes, insects, and marine organisms. These hydrophobic bonders possess high potential for use as natural substitutes for synthetic preservatives in the food products like the cheese, which makes the food products safer and with longer shelf life. Utilization of biotechnology methods like solvent and supercritical fluid extractions, as well as enzymatic extractions, helps to reach extracts with very good bioactive content. Such active extracts can be then be used in formulation of the food stuff to infuse antimicrobial and to enhance the quality of the product. Through integrated biotechnology, research and erudite will come up with ways of meeting the increasing needs of the food industries and consumers by providing them with safer and more nutritious food products (Silva *et al*., 2020) [1].

One of the crucial factors which should be taken into account in natural cheese-making process is the impact of microbes on flavour development and the formation of texture. On the other hand, some particular microorganisms either pathogens and spoilage bacteria are good at posing itself an important issue of cheese quality and safety instead of health. These microorganisms will find themselves in highly favorable conditions thus fostering rapid growth which leads to cheese spoilage and unwanted chemical transformations and consequently the compromised quality of cheese with lesser sensory attributes and lowered shelf life.

Firstly, besides dangerous pathogen bacteria in cheese like *Escherichia coli*, *Staphylococcus aureus* and *Enterococcus faecalis*, can adversely impact the consumer health by outbreak of foodborne illnesses or infections. Thus, the mentioned harmful microorganisms show the fact that we, as responsible food producers, must take seriously all steps to lower the level of microbial contamination in cheese production and comprehend that the safety of the final product is our primary task (Doulgeraki *et al*., 2012) [2].

Microorganisms are involved not only in the preservation or destruction of the cheese products, but also in their development. While serving as a natural flavor producer and contributing to texture enhancement, some microbes that represent undesirable spoilage agents are capable of causing development of undesirable chemical changes and therefore deterioration of sensory attributes and shelf life. As well as microbes contained in the cheese which have a potential to reach pathogenic status like *Escherichia coli*, *Staphylococcus aureus* and *Enterococcus faecalis* they present significant risks for the consumers; hence laws and regulations must be enforced to avoid microbial contamination within food industries. In this research, we will set out to delve into the development of novel ideas for increasing the security and array of quality of cheese products by having the addition of natural ingredients from ginger. The ginger extracts having antimicrobial properties are our key ingredients to create the cheese with their functions being to prevent microbial action while at the same time increasing its nutritional value and sensory appeal. As a result of the collaborative use of bio-technological processes and cheese manufacturing methods, the product will be a unique cheese product that not only satisfies the palate, but also guarantees the health and safety of the consumers. Through this work, we envision every part of the study process from the first step of research until through all the phases to be able to link the initial ambitions and hopes to the eventual results and impacts, so that the research is smoothly integrated, has relevance and is worthwhile (Wang *et al*., 2018) [3].

Dairy items in general and cheese as a quintessential one is consumed in all countries around the world, and so its significance in both culinary traditions and dietary habits is well understood across the cultures. People love it for its flavor, as it comes in so many different textures and has a nutritional count that is unmatched by anything in the world. It is a staple of so many dishes, from mere snacks to complex delicacies. Central to the delights of cheese is its extremely complicated texture, which is the result of joint activities of collocated constituents of milk mixes, process method as well as, in case there are, all ingredients or additives used in the perform of its production.

In the past years, there has been a signalling of a tick-marking shift in consumer choices of foods which are more organic, unprocessed and have cleaner labels, which could be an indication of growing health and environmental concerns. This approach stimulated a desire to develop and use more natural additives and functional plant-based ingredients for sensory, nutritional, and preservation-related properties, such as that of cheese.

One of the natural additives that has come into the investigation, especially for its infusion of the unusual active compounds, is ginger (*Zingiber officinale*). A ginger, cultivated from Zingiberaceae family, is an age-old medical and culinary plant known for its attribute flavor and medical functions. The active components of ginger, causing it to be useful for anti-inflammation and antioxidant activities as gingerol and shogaol volatile oils, phenolic compounds, and antioxidants have been studied (Butt *et al*., 2015) [17].

An integration of ginger and its derivatives into foodstuffs has been conducted to study how they can be used to enhance flavor, aroma and function within such products. In terms of cheese making, the use of ginger extracts has appeared to be a remarkable option that boosts the cheese sensory quality as well as nutritional composition. Moreover, the antimicrobial property of ginger extracts prolongs the shelf life of the cheese. Although some studies have tried to decipher the effect of ginger oil extracts on the composition of cheese and microbial quality, more research is thus necessary since the science literature on this is limited.

The goal for this investigation is to resolve the deficiency which is lack of systematic assessment of the contribution of ginger oils on the quality of the structure and microbiology of soft cheeses samples. The study will specifically centred on testing fat and ash content of cheese samples treated by varying concentrations of ginger oil extracts for their inhibitory efficacy against the boroughs of foodborne pathogens concerning food-related ailments.

The current study aims to disclose the ability of ginger oil extracts to influence cheese matrix and microbial quality during processing. This may advance the knowledge of the ginger's practical applications as a natural additive in cheese production. Besides the revelation of the working mode of ginger oil active element for the purpose of exerting their antimicrobial activities, it can also greatly facilitate the discovery of different strategies which may be applied to the food preservation and the dairy industries in the future.

By using a detailed approach and a thorough examination of the results, this study targets at improving the understanding of the implementation of natural additives in the production of cheeses and might as well lay the foundations for the creation of original cheese products with an improved sensory appeal, better nutritional profile and longer shelf life.

Significance of the Study

The utilization of natural supplements for instance, ginger oil extracts is an appropriate direction of those engaged in production of cheese as it increases the product value and matches consumer demands for all-natural and healthy food. By systematically evaluating the effects of ginger oil extracts on cheese composition and microbial quality, this study contributes to the advancement of knowledge in several key areas: By systematically evaluating the effects of ginger oil extracts on cheese composition and microbial quality (Haksar *et al*., 2006) [27], this study contributes to the advancement of knowledge in several key areas.

Functional Ingredients in Cheese Production

The application of functional ingredients, mostly from natural resources, is becoming popular as an alternative to enhance both the nutritional and the technological properties of food products. Through a study of the ginger oil extract as a natural ingredient in the inclusion in cheeses, this research project supplements the group of research devoted to the analyzing of various functional food ingredients in dairy products (Ramesh *et al*., 2018) [15].

Flavor and Aroma Enhancement: Among other ingredients, highly regarded is the gingers well-established distinct taste and smell. Ginger can provide food products with unusual sensory features by combining both. The addition of ginger oil extracts to cheese making can give new identity and innovation to your cheese without forcing to alter your preference of flavor (Karimi, Reza, 2011) [18].

Antimicrobial Preservation

Since microbial deterioration is one of the main issues in cheese manufacturing that can degrade the product's safety, and shelf life this problem has to be solved. With antimicrobial properties of ginger oil extracts, these products offer a more natural way to inhibit the growth of microorganisms and extend the shelf life of cheese products, thus improve food safety and decrease food wastefulness (Singh *et al*., 2008) [16].

Clean Label and Consumer Perception

The lasting trend of consumer appreciation for clean label products has grown to the point where there is increasing innovation when it comes to food. There is no artificial additives and preservatives being used on such consumer demands. By making use of natural ingredients like ginger added long-chain fatty acids, cheese manufacturers can give consumers what they want i.e. clean and natural ingredients and still maintain the quality and safety of their products (Chen *et al*., 2017) [5].

Sustainability and Environmental Impact

Incorporation of the organic components into cheese making falls into line with the green initiatives aimed at limiting the footprint in terms of sustainability. Through the use of natural ingredients like ginger and additional options of the ills extracts, the cheese companies are able to promote the sustainability and limit the use of synthetics and chemical preservatives (Carocho *et al*., 2015) [4].

Implications for Innovation

The findings of this study have far-reaching implications for cheese production and food industry innovation: The findings of this study have far-reaching implications for cheese production and food industry innovation.

Product Development: The outcome of this study helps agriculture in the cheese industry to develop improved cheese products with enhanced flavor, higher nutritional values, and longer shelf life. Incorporating consumer panel data collected could enable cheese manufacturers to use their knowledge to create better product compositions and meet the changing market demand (Hassan, Fatma, 2012) [21].

Process Optimization

Clear picture of the impact of ginger oil extracts on cheese making techniques and microbial quality gives cheese manufacturers the chance to regulate the production process by the rulebook and to provide customers with a uniform product. Via meticulous evaluation of formulations and process parameters variations such as healing efficiency and production cost savings are realized.

Market Differentiation: Cheese processed with natural additives like ginger oil extracts are more likely to sell amid the other cheese similar products having good market penetration while appealing real health conscious consumers looking for clean and whole foods. Capitalizing on a brand's own individual sensory and functional qualities gives specific category or product lines that competitive advantage it needs to stand out in the market (Yamprasert *et al*., 2020) [22].

Materials and Methods

Sample collection

In terms of soft white cheese production process, standard practice was sought in making the samples. There were two types of samples in each set. The first one is the control samples which contain no additives. While the experimental samples supplement with different amounts of ginger oil extracts was boosted with various concentrations of ginger oil extracts.

Soft White Cheese Preparation

A type of cheese, called soft white cheese or queso blanco is usually made by adding rennet to cow milk. The manufacturing process involves several steps, including: The manufacturing process involves several steps, including.

Milk Collection and Standardization

Freshest, addition, added high-quality cow's milk is then standardized for a consistent final product solution. The standardization process is conducted under the conditions where the fat content of the milk is adjusted to the specified level by blending different milk sources or adding cream. The milk samples were collected from distinct points, such as the city of Najaf and its adjacent suburbs, in order to provide a full range of samples for examination. Najaf, which is located in the center of Iraq, is the place where one of the shrines of the Shia Imams. For example, being a milk factory that's located in the center of town where many nearby neighborhoods feed the local dairy sector. In Sample collections that cover Najaf and a part of its suburbs, the quantification of milk quality and profile is given a geographical slant that aids the establishment of the contributing factors to dairy processing as well as production in this region.

Pasteurization: Pasteurization is used in order to eliminate body-harmful bacteria and germs without an impact on the flavor or food value. Pasteurisation can be carried by heating after the milk treatment. Through various devices, the temperature of the milk is heated until it is heated up to a given level for a definite period. In the conduction of these experiments, the pasteurization temperature was maintained at 63 °C, and the duration of pasteurization for 30 minutes was observed under these regulations. This factor utilization of temperature and time duration is approximately an adequate microbial reduction in milk which, on the other hand, results in the authenticity of the colour, taste, and scent of the product. This established uniform pasteurization protocol passes as the basic quality control of the dairy industry and also controls the safety and satisfactory conditions of the cheese and other dairy products while on consumer usage.

Inoculation with Starter Culture: A starter culture containing lactic acid bacteria (LAB), notably Lactococcus

lactis and Lactobacillus spp., is introduced to the pasteurized milk in order to accomplish this task. Bacteria digest the lactose (milk sugar), converting it into lactic acid which in turn acidifies the milk and creates the tangy and somewhat grainy texture of the cheese.

Coagulation: Because coagulation requires the addition of rennet or another enzyme, the coagulation starts to change not only the proteins but also other ingredients. Coagulation leads to the casein proteins (in milk) to retort as a gelatin-textured structure. Finally, you obtain the curd and the whey.

At the stage of coagulation in cheese manufacturing, the type of rennet, the way of add-in and the extracts' participation represent the pivotal factors that affect the whole product's final characteristics. What kind of rennet (animal- or microorganism-based) is used in the process has an impact on the taste, consistency, and positioning of a cheese. On the other hand, the method of how the rennet gets added, be it directly to the milk or the add-on of other ingredients, influences the rate and the way the coagulation spreads out.

In this case, microbial rennet being its consistently active enzyme and availability to the vegetarian customers was selected. Instruction was followed, according to the standard methods for adding the rennet into the milk. The mix was prepared in such a way that the curd was evenly distributed and separation took place in a timely manner. Additionally, I will delve into the possibility of using ginger oil extracts as a natural additives as well, which will be conducted to this end. The methodology adopted and materials used in the research study conducted to assess the effect of chemical food additives on the health of consumers will be discussed in the subsequent section. This step is focused on giving the cheese product a more flavorful complexity by adding ginger oil extracts and there is a potential for it to have extra antimicrobial elements.

With a mindful application of natural enzymes such as rennet and les is enzyme, the mode of addition and the inclusion of ginger oil and extracts, this study aim at optimal creation of the coagulation process and cheeses with outstanding sensory features as well as functional capacity. The study of the role and interaction of technological, nutritional, and environment conditions of cheese production is to be done through systematic experimentation and analysis aimed at developing new innovative cheese products with unique benefits for the market of healthy food products.

Cutting and Draining

The coagulation milk is cutting into smaller curdle, it therefore helps whey separate from the curd. Hence, the curds are beaten affectionately and cooked for the purpose of removing more whey. This results to the formation of a firmer mold.

Molding and Pressing

The curds are moved into molds, where they are pressed in order to get rid of more whey and give their external structure. The pressing process plays a significant role in the creation of the texture as it facilitates the formation of the curds and consolidates the mass. Salting: The salt content of cheese is influenced by whether the cheese is salted by pouring the salt directly into the curds or by soaking the curd in a saline solution. Salt actually intensifies flavour, and we can keep it fresh enough for all the time. Also, salt along with needed microflora creates a rind. Ripening (Optional): Some soft white cheeses are allowed to grow or mature for a short period which they keep becoming more flavorsome and satisfying. Ambient conditions, namely air temperature and air humidity, which determine the final quality of the fruits, are maintained under close supervision. Incorporation of Ginger Oil Extracts: In the experimental setup, it was stated that the different extracts of ginger oil were mixed with the all cheese samples in various concentrations.

The samples of cheese were then pressed to drain the whey and form a cheese block. The pressing of cheese that was done for 30 minutes and the rate of 0.5 kg of weight applied per 1 kg of cheese is the reason that made this cheese must to be eaten after 15 days of making it. The pressing of cheese from cheese production is a vital stage because it also goes with squeezing whey, compaction of the curds, and achieving the goal texture and shape of the cheese. Thus, the application of a dedicated pressure over some amount of time leads to the removal of extra water in other to have a harder cheese with the desired density. This protocol of carefully hair machine standardized pressing implies uniformity of cheese production stipulates that the quality and standing attributes of the final cheese product. The process likely involved the following steps:

Extracting Ginger Oil: It was necessary to clean, skin, and cut the fresh ginger rhizomes so that more area would be available for extraction. The ginger was at this stage, that is, chopped and then, using such extraction techniques as the alcohol or water, they were also extracted.

Concentration of Extracts

Following the extraction process, the oil extracts of ginger were concentrated using methods that could either be rotary evaporations or vacuum distillation. Removal of excess solvent to obtain bioactive components of the extracts being the purpose of concentration. Incorporation into Cheese: The ginger oil extracts concentrated were incorporated into the lattice samples at different ratios in compliance with the experimental design. Attention was paid to the proportion or reciprocation of different extracts and dairy liquids so they were adequately mixed with the cheese curds, which ensured homogeneous distribution throughout the cheese matrix.

Extraction of Ginger Oil: Ginger oil was extracted using the steam distillation method, which is described in the British Pharmacopoeia Anonymous for the year 1958 AD. It was done using a Clevenger device for light oil, and after drying the samples, 15 grams of it were placed in a volumetric flask and 400 ml of deionized water was added to it, using ether, as it separated into two layers. The upper part is taken and the remaining ether is evaporated using a rotary vacuum evaporator. After the extraction continues for 36 hours, the temperature is preserved and the oil is obtained in a Clevenger tube. The oil is placed in dark-colored bottles with a tight lid at a temperature of 4°C in the refrigerator until an examination is conducted. And diagnose the quality and quantity of active ingredients.

Experimental Design: The elimination of ginger oil extracts from soft white cheese is aimed at determining the

influence of its fat and ash content on the outcome of the cheese. In addition, the microbial activities of certain bacteria strains are also studied and evaluated. Our samples were designed to have control (T_1) and the treatment groups (Tgoil1, Tgoil2, Tgoil3), where Tgoil1 is the sample with the highest amount of ginger oil extract and T goil2 and Tgoil3 are the samples with the lower concentrations.

Fat Content Assessment

The process of lipolysis fatty acid from samples was done by the path followed by Gerber method (Hafizur *et al*., 2016) [7]. The hard fats of these cheese samples were treated with sulfuric acid and amylolytic enzymes. Then, the cheese samples were ground to a very fine particle size and gently washed as this procedure would help in the elimination of impurities. In addition to that, the calculated fat matter concentrated (Singh *et al*., 2017) [8] might be brought by transheld of the oil volume released by centrifugation.

Inhibitory Effectiveness Assay

The main purpose of this research was to determine the rate of the inhibition factor of the microbial growth of ginger oil, alcohol, and water vortices. Ginger inhibitions were affected by strain and concentration of ginger oil (Mohamed *et al*., 2019) [11]. Then, the cells were properly plated on to a nutrient agar plate and Petri dishes were covered and twisted for well creation on the edge. They filled with of the flasks equal amounts with ginger oil, ethanol, and filter water which were then placed in a temperature controlled room in dual fashion arrangement. Inhibition zone was measured to ensure the strength of extract obtained from those locations where pollutants are directly indulging. The size of the dug wells became an instrument used for advancing the capacity of the area to withstand the spread too much bacteria at camp.

Ash Content Assessment

The residue produced being the ash obtained from the cheese samples was studied by burning the residue in a combustion chamber until total combustion (Devi *et al*., 2015) [9]. The residue was weighed, and then the taken mass was converted into percent by dividing by the starting mass (Kumar *et al*., 2018) [10].

Standardization of Concentrations: The amounts of ginger oil extracts added to the cheese samples may beset in advance with the experiment which is planned to determine the methodology (Nguyen *et al*., 2020) [13]. Different levels of PEF could be investigated individually to check their effect on some dimension of the food, including fat and ash content. They can also serve in the antibacterial tests. This research explored the potential effects of ginger oil extracts on the cheese samples by including them in the study to gain information on its composition as well as the microbial quality. The explorative approach is very helpful in figuring out the features of ginger oil in a food matrix and also investigates its prospect as natural preservative and flavoring in cheese making (Ojha *et al*., 2016) [14].

Statistical Analysis: The statistical investigations were done using appropriate statistical tools (e.g., ANOVA) to depict the significant differences between the group of control and group of treatments of the fat and ash level as well as the anti-bacterial efficacy against the bacterial strains. P-value was 0.05, which implied the statistical significance.

Data Interpretation: Statistical analytical methods aid researchers to draw conclusion based solely on data gathered from their experiments. It provides them the tool to find resemblance, links and patterns among all dataset.

Quantifying Uncertainty: Through statistical methods in which measures of variability, uncertainty and reliability are estimated. Study findings from the research will be provided the way to quantify the reliability and precision of the study findings.

Hypothesis Testing: Typically, the researchers do either propose the hypotheses or answer the research questions and then apply the statistical tests, which tell them whether the data collected provide evidence in support of or refutation of the proposed hypotheses. Postulating enabled researchers to come to conclusions following the available evidence, though with the uncertainty.

Comparing Treatment Groups: Experimentation studies such the study being discussed in the results will provide statistical results when different treatment or condition groups are compared. As an illustration, the fat and ash content of cheddar cheese samples including and without ginger oil extracts can be compared by the researchers to know if there is any significant difference resulting from the addition of the extracts.

Determining Significance: Statistical tests are employed to ensure that difference between groups observed in the measurements are statistically significant or not, just by random effects. It implies that the only perceived difference arises from other factors that are being actively examined, for instance, due to the producing ginger oil extracts.

Identifying Relationships: Another statistical comprehension (or analysis) sorting out of correlations or other associations between variables is also possible. As an example, scientists can study the correlation between the level of ginger oil extracts added to cheese samples and their ferrulates ability to halt the growth of particular strains of bacteria.

Through the example presented of the research results, probably, statistical analysis refers to the use of the statistical calculations of proper statistics test to the compare the mean fat and ash content between the control and the fermented cheese. To illustrate this, the motif of the unity in diversity in Oberlin Rifenbarger's novel is used as an illustration. The conventional statistical tests which are important for this kind of assessments typically include ANOVA, t-tests, regression analysis, and correlation analysis, together with all other tests.

Results

Fat Content Assessment in Cheese Samples

In Figure (1), representing the chemical composition of soft white cheese samples and samples added with ginger oil extracts, fat content results are presented. The fat percentage in the control sample, T_1, was 14.36, while the fat percentage in the sample added with ginger oil extract at the first concentration, Tgoil1, was 19.11, indicating the highest

fat content among the treatments. The fat percentages for the second (Tgoil2) and third (Tgoil3) concentrations of ginger oil extract were 18.27 and 18.13, respectively. The sample with the first concentration of ginger oil extract exhibited the highest fat content.

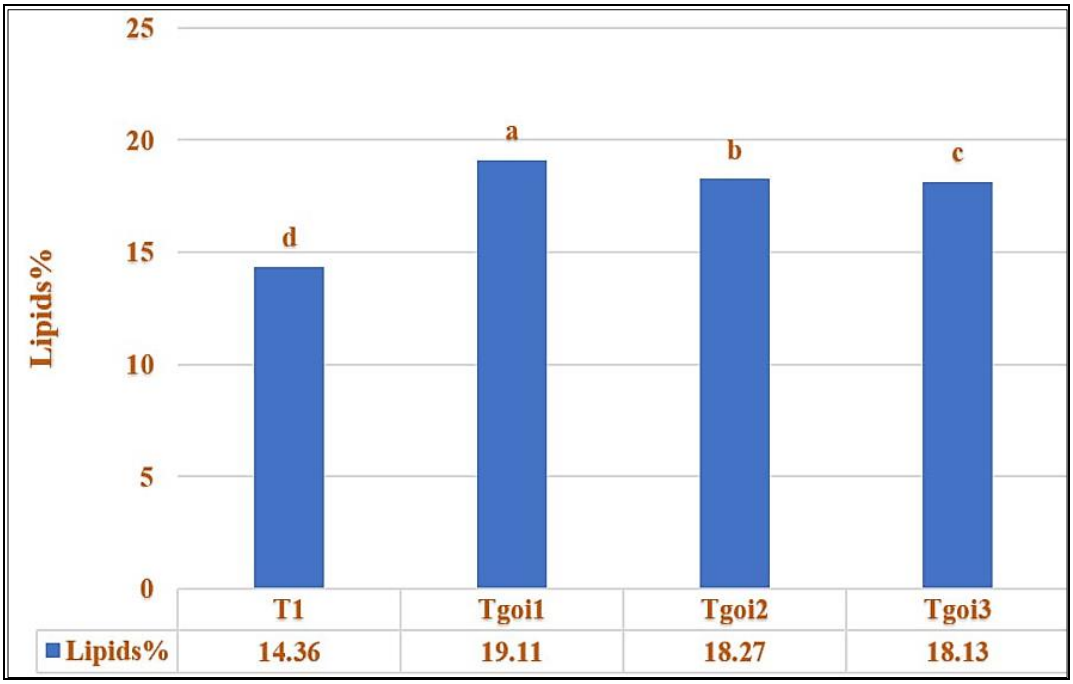


Fig 1: Fat Content assessment in cheese samples

Ash Content Assessment in Cheese Samples

The ash content results for soft white cheese (control) and cheese added with ginger oil extracts are shown in Figure (2). The ash percentage for the control sample was (0.94, 0.96, 0.99) for three replicates, while the ash percentages for samples added with ginger oil extract were (1.02, 1.0, 0.98), (0.88, 0.4, 1.22) for alcohol extract, and (0.94, 0.98, 1) for water extract. Statistical analysis indicated a significant impact on ash content due to the type of added extract during cheese manufacturing compared to the control cheese.

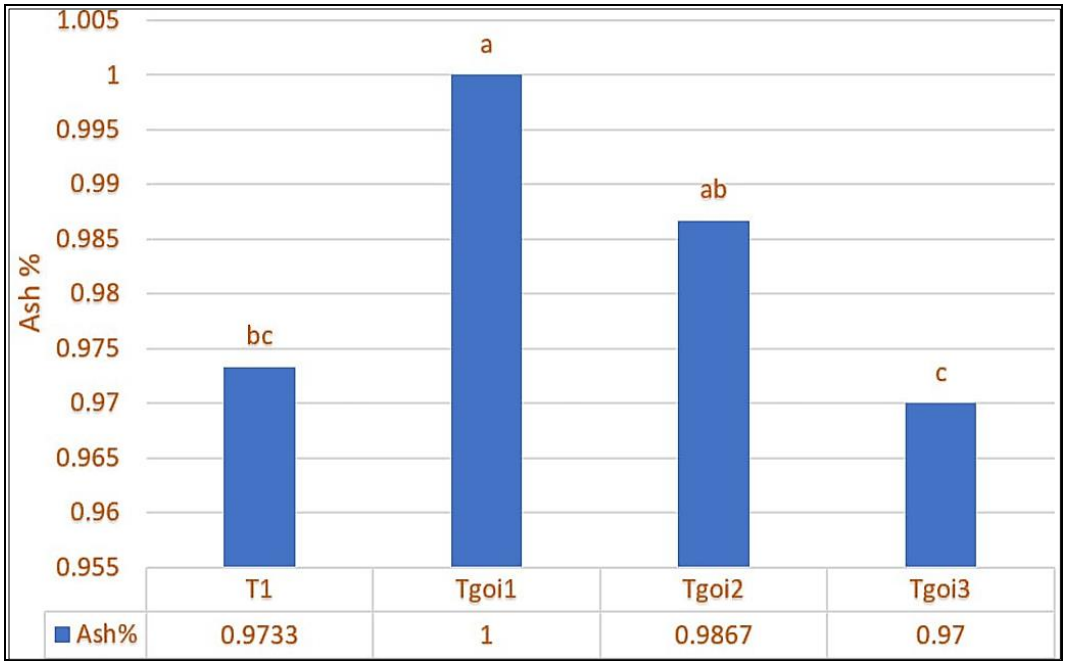
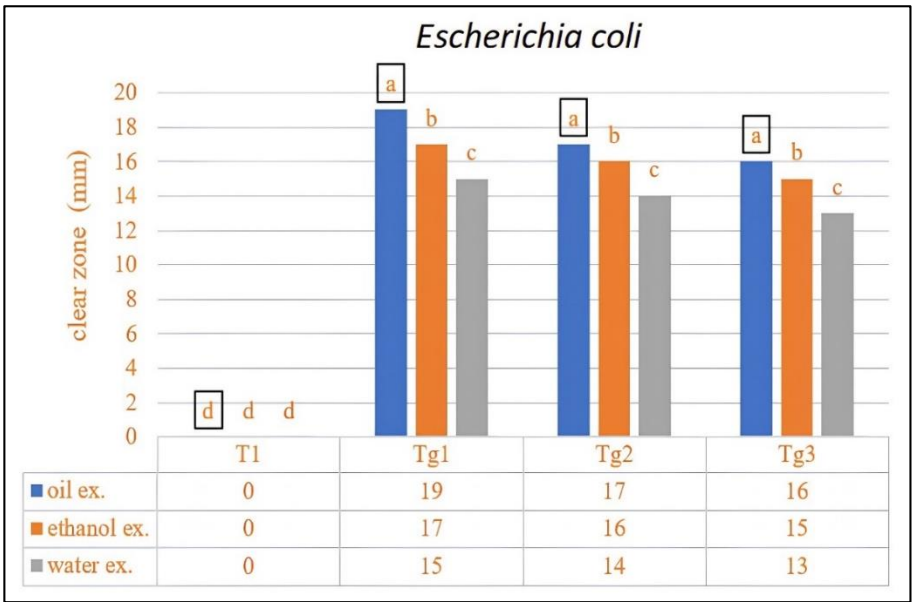


Fig 2: Ash content assessment in cheese samples

Inhibitory Effectiveness on Bacteria by Ginger Oil, Alcohol, and Water Extracts

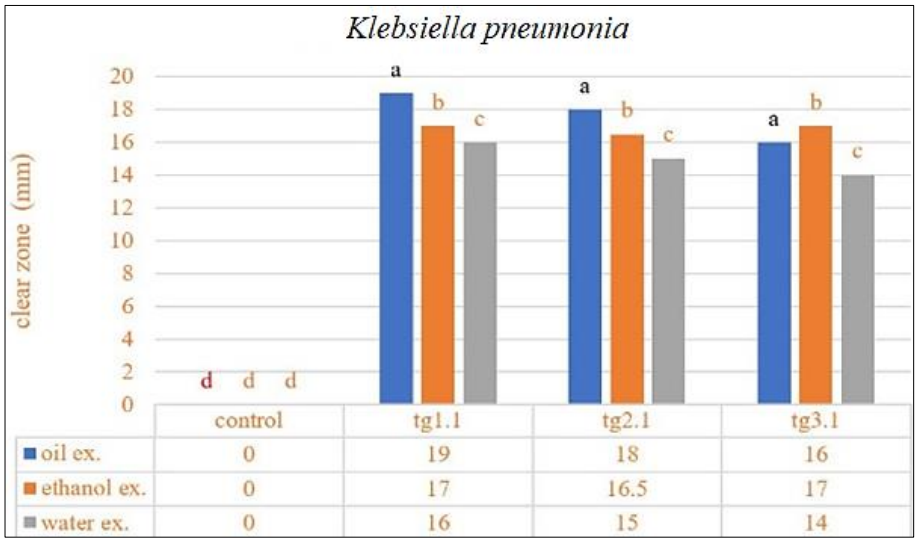
The inhibitory effectiveness of ginger oil, alcohol, and water extracts on bacteria is demonstrated in Figure (3, 4, 5, and 6). Results indicate a positive effect on limiting bacterial growth. For *E. coli*, the most effective treatment was Tg1, showing a diameter of inhibition (19 mm). The inhibitory effectiveness against Klebsiella pneumonia was most prominent in Tg1 (18mm), and for *Staphylococcus aureus*, Tg1 demonstrated the highest inhibitory diameter (21 mm).

For *Enterococcus faecalis*, Tg1 also exhibited the most significant inhibitory effect with a diameter of (19 mm).



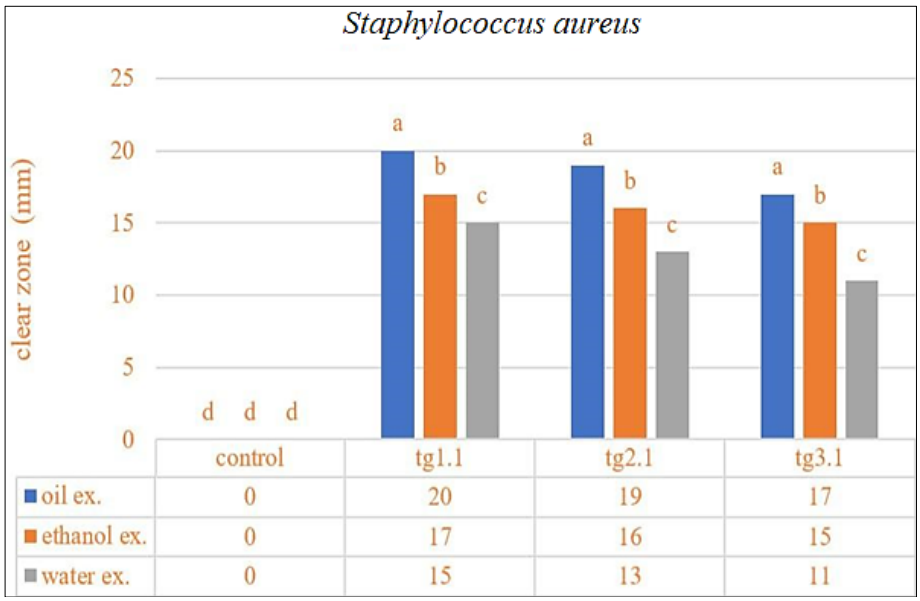
	T1	Tg1	Tg2	Tg3
oil ex.	0	19	17	16
ethanol ex.	0	17	16	15
water ex.	0	15	14	13

Fig 3: Inhibitory effectiveness on *E. coli* bacteria by ginger oil, alcohol, and water extracts



	control	tg1.1	tg2.1	tg3.1
oil ex.	0	19	18	16
ethanol ex.	0	17	16.5	17
water ex.	0	16	15	14

Fig 4: Inhibitory effectiveness on Klebsiella pneumonia bacteria by ginger oil, alcohol, and water extracts



	control	tg1.1	tg2.1	tg3.1
oil ex.	0	20	19	17
ethanol ex.	0	17	16	15
water ex.	0	15	13	11

Fig 5: Inhibitory effectiveness on *Staphylococcus aureus* bacteria by ginger oil, alcohol, and water extracts

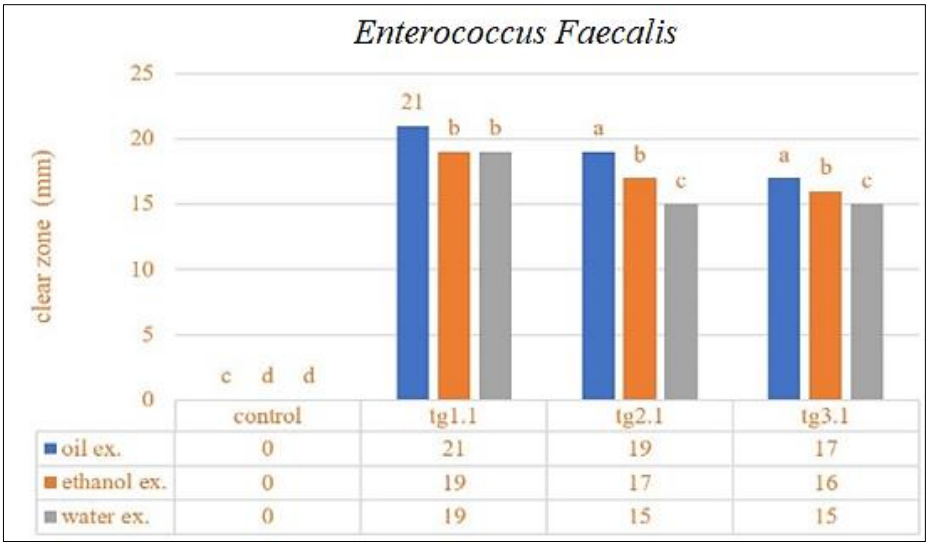


Fig 6: Inhibitory effectiveness on *Enterococcus faecalis* bacteria by ginger oil, alcohol, and water extracts

Discussion

In this research, we investigated the effect of mixing the ginger oil into cheese production process, and the effect of it on: the content of fat, the effectiveness of inhibiting microorganisms, and the overall quality parameters. Data we gathered led to the identification of a considerable number of parameters which has facilitated the evaluation of whether ginger has any benefits to be used in cheese making.

This study find that the ginger oil infusion affect the content and microbial quality of cheese samples and also show how it can be used in making cheese. Consequently, the investigations which were conducted on fat content displayed that the cheese samples added with ginger oil extracts had a relatively higher fat content than control samples. Therefore this observation indicates that the usage of ginger oily extracts can theoretically raise the fat content in cheese which make cheese taste delicious with smooth effect in the mouth. We begin by assessing the fat contents of cheese samples treated with different concentrations of ginger oil extracts. It was seen that the highest fat content was observed in samples treated with the first tested concentration of the extract. It is translated into the fact that the processing cheese with ginger powder can lead to the elevating the level of fat which is a strong hint for the opportunity to enhance the nutritional value of the cheese, referring to the results of the recent works (Ritota M, *et al*. 2020) [20].

The baselines for ash contain along the control and treated samples demonstrated differences. Although the specific mechanisms underlying the mineral variation remain uncertain for which further investigation is required, it is logical to predict that the incorporation of ginger oil may be able to adjust the content of ash of cheese, hence the mineral variation, which of course would create differences in ash content. The increased potassium and calcium content in ash evidently suggests a dietary supplement of ginger oil extracts may improve the nutritional calories of cheese, adding potassium, iron, and phosphorus at the same time.

Moreover, the investigations of the ginger oil, alcohol, and water extracts against microorganisms, which were carried out, demonstrated extremely good results with the ginger oil yielding the most pronounced antibacterial action. It also confirms, in effect, that other studies as (Nadifah & Sari, 2016) [34] earlier came out to similar line of findings, resulting in the antimicrobial characteristics of ginger which could be used in delayed cheese preservation.

Additionally, the antibacterial activity has been evaluated by the growth inhibition endpoint method which confirmed the anti-microbial activity of ginger oil extracts against different bacteria strains which are major contributors to foodborne disease. The extremely obvious complete growth inhibition areas in the cheese samples treated with ginger oil extracts represent that they may able to prevent bacteria from growing and limit bacteria presence in cheese products. These results correspond with other studies regarding the antibacterial activity of ginger and invigorates the possibility of utilization of this condiment as a natural preservative in curd production.

The standardized ginger oil concentration grafted into cheese samples facilitated a focused evaluation on the effects of such substance on fat and ash content as well as on its antibacterial property. The study's exploratory strategy enriched understanding of how ginger oil extracts could be applied in cheese-making and their potential impact. The trial tried to explain how the effects of ginger oil mainly on cheese composition and microbial quality lie on the conduct of research that enhances the secondary use of natural additives in dairy products.

While the investigation in (Anita P, *et al*., 2014) [35] study focused only on a few certain parameters such as ash content with ripening indices and bacteriological ones, another work examined the properties of cheese quality more broadly giving additional data to the ones obtained. Although, two studies nevertheless gave insights into different aspects of the subject; a comparative analysis of design and findings could signify that the study of the effects of ginger extract on the cheese making can be a complex issue.

In short, there is a number of advantages in cheese production of adding ginger oil extraction which are changes in the chemical features, growth of microbial quality and possibility of prolonging the shelf-life of products. Although the studies related to this topic are not sufficient, there is an optimistic outlook to uncover the unknown mechanisms and improve the efficiency of cheese formulation that involves ginger oil. Therefore, chemoreceptor evaluation studies are required to test the

efficacy of ginger oil extracts on the sensory components in cheese and consumers' acceptance. By means of yet further research, ginger oil compounds could become the choice natural ingredient for improving the quality and safety of cheeses. These additives may be used, as consumers adapt tastes and preferences towards natural, healthy, and tasty food products.

Conclusion

It comes to an end, this study represented information on the influence of extract from ginger oil to the composition and the microbial quality of soft white cheese samples. Through systematic experimentation and analysis, several key findings have emerged: Through systematic experimentation and analysis, several key findings have emerged.

Firstly, the addition of ginger extracts into the composition had similar impacts on the percentage of total amount of fats and ashes present in cheese samples; the more the concentration of ginger was the higher the fat content was. This finding, however, may expose ginger oil extracts to being the subject of future investigations that may reveal the effect on the composition of cheese, a delicacy that is nutritional and sensory friendly.

Additionally, the inhibitory systematic test provided considerable antimicrobial purposes of ginger oil extracts against some bacterial strain that generally fuel the type of foodborne disease. This result has therefore pointed out the possibility of ginger oil extracts to be employed as effective natural preservatives in cheese products to control microbial growth, bring about considerable safety, and increase shelf life.

Ultimately, unfolding of this study gives further insight into positive attributes gained by adopting ginger oil extracts among cheese productions, namely in composition, sensorial characteristic, and microbial quality. Given that cheese naturally contains vitamins, minerals, and beneficial bacteria, these insights are of great importance to cheese manufacturers who strive to create innovative cheese combinations and meet consumers' demand for healthy, natural, and tasty cheese products.

Moving on, a research entity is then needed to examine the mechanisms behind the described effects of ginger oil extracts on cheese composition and microbial quality. Besides, further investigation into consumer preference for the sensory sensitivity and perception of the supplemented ginger oil extracts cheese products is significant in determining the market potential and consumer acceptance.

The results of this research will be of high reference value in the field of the usage of natural additives for cheese production and thereby will be a revelation in developing those cheese products which meet modern consumers' needs and tastes.

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