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Effect of Addition of Garlic and Ginger Powder on Physicochemical, Microbiological and Organoleptic Characteristics of White Cheese

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Abstract

This study aimed to investigate physicochemical, microbiological and sensory properties of white cheese made from different levels of garlic and ginger powder. Cheese samples were processed by adding garlic and ginger powder at 0, 2, 4 and 6% by weight concentration. Standard methods were used in this research to determine the physiochemical, microbiological and sensory properties of all cheese samples. The results of the proximate analysis indicated the highest moisture content in control was 45.10%, and lowest one in 6% garlic was (36.77%). The protein content of cheese processed by using ginger powder were (18.37, 19.25, 19.68%) in 2, 4, 6%, respectively, while in cheese processed by using garlic powder were (15.31, 17.06,17.5%) in 2, 4, 6%, respectively. Statistically, significant differences (p<0.005). The highest fat content in cheese processed by using garlic powder were (25.58, 25.30, 25.18%) in 2, 4, 6%, respectively, while the cheese processed by using ginger powder had the lowest fat content were (24.16, 23.14, 22.1%) in 2, 4, 6%, respectively. The mineral content statistically, affected (p<0.005) by adding ginger and garlic powder. The ash content increased by the increase of the level of garlic and ginger powder, the highest one in cheese with 6% garlic powder was (4.77%). Titratable acidity and pH were significantly affected (p<0.005) by added garlic and ginger powder. The total solids content of cheese sample increased significantly (p<0.005) by increased garlic and ginger powder when the highest one was recorded in cheese sample produced by 6% of garlic powder addition (63.23%). The results obtained from the microbiological analysis of cheese samples showed that the lowest counts of yeast and moulds were observed for cheese samples produced by 6% garlic powder. *Coliform* and *Salmonella* count were not detected in processed cheese by different levels of garlic and ginger powder. The sensory evaluation indicated that the panellists accepted all cheese samples concerning the cheese prepared by the addition of garlic powder compared to that prepared by addition of ginger powder. According to the results of this study, it can be recommended that further studies for the assessment of the antioxidant effect of garlic and ginger powder to improve the quality of white cheese.

Keywords: Ginger; White cheese; Physiochemical properties; Microbiological characteristics; Sensory evaluation

Introduction

Cheese is one of the most widely consumed fermented dairy products with growing consumer demand. It is an excellent dietary source of high-quality protein, vitamins and minerals such as absorbable dietary calcium. Hundreds of types of cheese are produced in the world. Their styles, textures and flavours depend on the origin of milk, animal diet, butterfat content, bacteria and mould, the processing, and ageing conditions [1]. Definition of cheese, a concentrated dairy food made from milk, is defined as the fresh or matured product obtained by draining the whey (the moisture or serum of the original milk) after coagulation of casein, milk's [2]. Cheese is a vital fermented dairy product which had a major role in human nutrition for centuries. It is an excellent tasty, 99% digestible energy food, which is suitable for all age groups and contains high-quality proteins [3]. The processes involved are acidification, coagulation, cooking, salting, dehydration or syneresis, and pressing, packaging and maturation or storage [4]. There are two main types of cheeses in Sudan white cheese (Jibnabeida), and braided semi-hard cheese (Mudaffarra) other types of cheese provided recently by Sudanese industries are Mozzarella and Gouda cheese. White cheese (Jibna-Beida) is the most common kind of cheese on the Sudanese market available to the public [5]. The processing of Jibna-Beida is done traditionally, begins by receiving cow's raw milk which is strained and mixed with salt in a clean petrol drum. Then 4 or 5 rennet tablets (8-10g) are crushed, suspended in a little water and added to each drum, with constant stirring. The milk is next covered with cheesecloth and left to coagulate within 4-6 hours. The curd is transferred to wooden moulds lined with cheesecloth and left to drain overnight. The cheese obtained is cut into cubes and placed into petrol cans. The whey is added to the cheese to immerse it completely and the cans hermetically sealed by soldering. Cheese is then stored

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for ripening [6]. Garlic, *Allium sativum L.* is a member of the *Alliaceae* family, has been widely recognized as a valuable spice and a popular remedy for various ailments and physiological disorders. Garlic's current principal medicinal uses are to prevent and treat cardiovascular disease by lowering blood pressure and cholesterol, as an antimicrobial, and as a preventive agent for cancer [7]. Garlic as an antimicrobial is a topical and systemic antimicrobial agent Allicin has antimicrobial effects *in vitro* against many viruses, bacteria, fungi and parasites, but dried, powdered and oil preparations of garlic have not been shown to have significant antimicrobial activity [8]. Garlic as antioxidant exhibit direct antioxidant effects and enhance the serum levels of two antioxidant enzymes, catalase and glutathione peroxidase. Ginger (*Zingiber officinale Rosco*) a member of the family *Zingiberaceae*, is used worldwide as a cooking spice, condiment and herbal remedy. It was also used to treat baldness, toothache, and respiratory conditions. Reduce cholesterol and fight arthritis [9]. This study was aimed to determine the physicochemical, microbiological and sensory characteristics of white cheese made from different levels of ginger and garlic powder.

Materials and Methods

Materials

Fresh whole cow milk was obtained from the wad Elmagdob farm, Gezira State, Sudan. Milk was immediately cooled to 4°C-fresh garlic and ginger collected from a local market in Wad Medani city, Gezira State, Sudan. All the glassware media and other materials used were either wet sterilized or dry sterilised. The dry sterilisation was done by the oven at 160°C for 2 hours, while wet sterilization was carried out in an autoclave at 121°C for 15 minutes. The media were prepared according to the manufacturer's instructions. All other chemicals and reagents will be of the highest grade commercially available.

Methods

Preparation of ginger and garlic powder: Fresh ginger was thoroughly washed, and sun-dried to a final and then ground into powder using electric kitchen grinder the powder was be sieved with a wire mesh [10]. For garlic, after removing the outer cover, garlic cloves were peeled off washed with clean water; sliced with a sharp knife and sun-dried to a final moisture content of 10%. The slices were then ground into powder using electric kitchen grinder. The powder was sieved with a wire mesh [11].

Cheese manufacture: Ten liters of cow milk was taken for each sample in a stainless-steel container and heated to 60°C for 30 minutes. After pasteurisation the milk was cooled to 40°C rennet powder (1gram/50 litres) was added to milk at 40°C. The salt was added at 2% and then mixed with the milk. Three types of cheese were prepared, the first type was left free without any additive of garlic and ginger powder, the second type was addition ginger powder at the levels of 2, 4, and 6% to the milk respectively, third type was addition garlic powder at the levels of 2, 4, and 6% to the milk respectively, and after addition of the powder the milk put in the incubator about one hour for coagulation of the milk. The curd was poured into small clean wooden moulds lined with cheesecloth and press overnight. The curd was then cut into small cubes and put in the whey water for ripening three days. The manufactured cheese samples were packaged in packaging, sampled, stored with whey at 4°C for 15 days for further revaluation.

Table 1: Chemical composition of milk sample.

Parameter	Raw milk
Moisture	83.00±0.04
Total Solid	11.98±0.03
Fat	3.72±0.06
Protein	3.39±0.09
Lactose	4.92±0.3
Ash	2.89±0.01
Acidity	0.16±0.07
pH	6.80±0.03

Moisture content: The moisture content of the different samples was determined according to [12]. Six porcelain dishes were taken, washed and dried for one hour at 100°C by the oven, then cooled down to room temperature in a desiccator for 30 min, and weighed; 5g of cheese samples were taken and placed in porcelain dishes. The dish with the sample was then dried for two hours at 105°C and cooled down in desiccators and weighed.

pH measurement: pH value was measured using an electric pH meter model 501 according to [12]. pH meter was used to measure the pH of cheese sample, 3-gram cheese was weighed and crushed with 10ml water in a porcelain mortar. This suspension was poured into a small glass beaker. The pH and temperature probes were suspended in the liquid until the pH meter indicated a stable reading.

Titratable acidity determination: The Titratable Acidity (TA) of cheese describe by [13] was used to determine the titratable acidity, where 3-gram cheese was weighed and crushed with 10ml water in a porcelain mortar. This solution was transferred into an Erlenmeyer flask five drops phenolphthalein was added and titrated with 0.1N NaOH to the first permanent colour change to pink.

Total solid content: Total solid was determined by [14], heating 5g of the sample in an oven at 100°C for 3 hours.

Protein Content: The protein content was determined by Kjeldahl method [15]. In a clean, dry Kjeldahl flask, 1g of cheese sample was placed, and then 25ml of concerted H_2SO_4 and catalyst (KSO_4 + $CuSO_4$) were added. The mixture was then digested on a heater until a clear solution was obtained after 3 Hours. The flasks were removed and left to cool. The digested sample was poured into a volumetric flask (100ml) and diluted to 100ml with distilled water. Then 20ml were taken, neutralized using 50ml of 40% Sodium Hydroxide (NAOH) and the neutralized solution was then distilled. The distillate was received in a conical flask containing 25ml of 4% boric acid plus three drops of indicator. The distillation was continued until the volume of the flask was 75ml. The flask was then removed from the distillatory, and the distillate was then titrated against 0.IN HCL the end was obtained.

Ash content: The ash content was determined according to the AOAC method, [14] using five grams of defatted sample was ignited at 500°C in a muffle furnace for two h until a black colour appeared. After cooling in desiccators, they were weighed. The difference in weight before and after burning process give the percent ash content obtained using the standard formula.

Table 2: Physiochemical composition (%) of processed cheese with the addition of ginger powder.

Parameters	Control sample	Ratio		
		2%	4%	6%
Moisture%	45.10±0.11^{a}	42.50±0.07^{b}	41.73±0.13^{b}	40.67±0.10^{c}
Protein%	16.18±0.10^{c}	18.37±0.04^{b}	19.25±0.24^{ab}	19.68±0.10^{a}
Fat %	26.61±0.08^{a}	24.16±0.22^{ab}	23.14±0.23^{b}	22.1±0.09^{c}
Ash%	3.98±0.11^{d}	4.10±0.12^{c}	4.30±0.12^{b}	4.43±0.12^{a}
pH	4.43±0.21^{a}	4.38±0.09^{b}	4.34±0.09^{b}	4.32±0.05^{b}
Titratable acidity	0.96±0.13^{d}	1.22±0.11^{c}	1.32±0.03^{b}	1.44±0.09^{a}
Total Solids%	54.90±0.09^{c}	57.4±0.13^{b}	58.27±0.11^{ab}	59.33±0.11^{a}

Mean values ± standard deviation having a different superscript letter(s) in each row differ significantly (P<0.005).

Determination of minerals

Determination of Sodium (Na^{+}), calcium (Ca^{+}) and potassium(K^{+}) concentrations were accomplished by a flame photometer (model corning, 400) according to the AOAC Official Method, (1970). Sodium stock solution, about 2.54g of NaCl were dissolved in distilled water and diluted to 1litre ''1000ppm Na/ml'', and then 10ml of solution were taken and diluted by distilled water to give 100ppm Na/ml. Potassium stock solution, about 1.91g of KCl were dissolved in distilled water and diluted to 1litre ''1000ppm K/ml'', and then 10 ml of solution were taken and diluted by distilled water to give 100ppm K/ml. Calcium stock solution, about 1.91g of $CaCl_2$ were dissolved in distilled water and diluted to 1litre ''1000ppm Ca/ml'', and then 10ml of solution were taken and diluted by distilled water to give 100ppm Ca/ml. The procedure, in brief, different concentrations (20, 40, 60, 80,100 ppm) were prepared from a stock solution of Na, Ca, and K. Then by using the flame photometer the reading taken and a graph was made. The sample was prepared by weighing 5gm of ash then the sample dissolved in distilled water and 0.1N HCl was added to make 1000ml. About 10ml were then taken and diluted to 100ml, and then 5ml was taken and diluted to 100ml to give 100ppm.

Fat content determination

The fat content was determined by Gerber method according to [15] as follows: 10g of cheese sample was taken, 10ml sulfuric acid and 1ml of amyl alcohol was added to it and close with a rubber cork. And centrifuged at 1100 evaluations per minute (rpm) for 15 minutes and the tubes were then transferred to a bath at 65°C for 5 minutes. The fat per cent was then read out directly from the fat column.

Chemical analysis of raw milk

The various chemical analysis which included moisture, total solids, fat, protein, lactose, ash, titratable acidity and pH of raw milk were determined by used milk and instrumental.

Preparation of serial dilution

Ten-gram samples of cheese type were homogenized with 90ml of distilled water by shaking for several minutes, from this suspension; 1ml was taken from the dilution and transferred to another tube to make serial dilution up to 10-6.

Total bacterial count

The total viable count per ml of sample was obtained by pour-plating suitable in triplicates on plate Count Ager (Oxoid) following the method of [16]. Incubation was accomplished at 37°C for 48 hours. Plates containing 30-300 Colonies were counted as Colony Forming Units (C.F.U) per ml of the sample.

Table 3: Minerals content (mg/100g) of processed cheese by added ginger powder.

Element	Control sample	Ratio		
		2%	4%	6%
Sodium (mg/100g)	83.33±0.04^{b}	87.33±0.11^{a}	75.33±0.22^{c}	75.23±0.11^{c}
Potassium (mg/100g)	60±1.73^{a}	58.33±0.11^{b}	55.33±0.09^{c}	54.33±0.14^{d}
Calcium (mg/100g)	380.00±0.22^{a}	380.67±0.12^{a}	378.00±0.11^{b}	378.33±0.12^{b}

Mean values ± standard deviation having a different superscript letter(s) in each row differ significantly (*P*<0.005).

Yeast and mould count

Yeast and mould were enumerated according to [17] using Potato Dextrose Agar (PDA). The plates were incubated at 25°C for 3-5 days, plates containing 30-300 colonies were counted as Colony Forming Units (C.F.U/ml).

Coliform count

Coliform bacterial count was determined according to [18] using Mac Conkey broth. The tubes were incubated at 37°C for 48 hours. Positive tubes gave gas in Durham tubes. Then the positive tubes were subcultured into EC broth medium and then incubated at 44°C for 24 hours to determine the *Coliform bacteria*, the tube showing any amount of gas production were considered positive.

Salmonella count

100ml of samples were incubated at 37°C for 24 hours. Then 10ml were drawn aseptically and added to 100ml Selenite Broth. The broth was incubated at 37°C for 24 hours then with a loopful streaking was done on dried Bismuth Sulphite agar plates. The plates were then incubated at 37°C for 72 hours. Black metallic sheen discrete colonies indicated the presence of *Salmonella*. A confirmatory test was carried out by taking a discrete black.

Sensory evaluation

White cheese samples were subjected to sensory evaluation using (10) panellists, the panellists were asked to assess each sample for colour, appearance, flavour, texture and overall acceptability a 9-point hedonic scale with one as the extremely bad and nine the excellent. All analysis took place in a room free from disturbing noises, and in which fresh air was circulation conditions were equalized for all the tests. The order of presentation for samples was randomized and the samples were given codes before being tested.

Statistical analysis

Statistical analysis was done using Statistical Package for Social Studies Software SPSS. Complete Randomized Design was used to estimate chemical, microbiological and sensory characteristics of the white cheese.

Results and Discussion

The physiochemical composition of processed cheese by the addition of garlic powder

The chemical composition of raw milk sample used for the production of white cheese is presented in (Table 1). The moisture content of raw milk (85%) was lower when compared to [19] which

was 87.31%. The moisture content value was in close agreement with the moisture content of raw cow's milk. The total solids content of raw milk was 11.98% and found to be similar value was reported by [20] which was 11.58%. These results were in with those agreements with those reported by [21], which was 11.70%. The fat content of raw milk (3.72%) was higher when compared to the milk sample of [19], which was 2.77%. The fat content of raw milk was in close agreement with that reported by [21], who found fat content of 3.70%. The protein content of raw milk (3.39%) was lower when compared with [20], which was 4.14%. The protein content values were in close agreement to the protein content of raw milk as reported by [21], which was 3.38%. The lactose content was 4.92%inagreement to the lactose content of raw milk as reported by [19], which was 4.97%. (Table 1) also, shows that the ash content of raw milk 2.89. This result agreed with that of [19] who reported a value of 2.88%, while the titratable acidity of raw milk 0.16 % was lower. The titratable acidity value of raw milk was in agreement to the titratable acidity reported by [21], which was 0.19%. The data presented in (Table 1), also showed that the pH value of raw milk was 6.70%, this value was an agreement to that reported by [19] who found a pH value of 6.71% in raw milk.

The physiochemical composition of processed cheese by addition of ginger powder

The chemical composition of processed white cheese with different concentrations of ginger powder (2, 4 and 6% g/g) is shown in (Table 2). The value of moisture content in control was 45.10%, this value was found to be higher than other found in cheese with 2,4,6% ginger which was 42.50%, 41.73% and 40.67%, respectively and statistically, significant differences ($p<0.005$) in moisture content of different concentrations of ginger powder in cheese samples were found, this result was lower than reported by [22], which was 68.97,64.78%, due to the addition of powder decreases the moisture content in cheese. The data presented in (Table 4&2) also, showed that the protein content of cheese sample was 16.18,18.37, 19.25 and 19.68% in control l, 2, 4 and 6%, respectively, and statistically, significant differences ($p<0.005$) in protein content of different concentrations of ginger powder in cheese samples were found. The highest protein content was (19.68%) was recorded in cheese sample produced by 6% of ginger powder and while the lowest one in the control sample, which was 16.18%. This result was similar to that value was reported by [22], which was 19.70%. The fat content in control sample was 26.61%, this value was higher than found in cheese sample processed by added ginger powder in ratio 2, 4 and 6% which were 24.16, 23.14, and 22.1%, respectively. These values were in close agreement to that reported by [23] which was 25.93% and higher than reported by [22] which was 13.63%. This study showed significant variation ($P<0.005$) between cheese samples in fat content. The ash value in control was 3.98% is lower than other cheese sample processed by different levels of ginger powder 2, 4 and 6%, which were 4.10, 4.30 and 4.43%, respectively. This result was in line with those found by [22], which was 5.20%. Also, these results were higher than that reported by [24] which were 1.34, 1.34, 1.35% in 1, 3, 5% respectively. Statistically, there are significant variations ($P<0.005$) between cheese samples in ash content. On the other hand, the pH value in (Table 4&2), control sample was 4.43 this value in line with those found in cheese with 2, 4 and 6% ginger powder which were 4.38, 4.34, 4.32% respectively, did not show significant different ($P>0.005$) effect on the pH value of the samples. These results were in close agreement with those reported by [24], of Ayib sample treated with ginger powder which was 4.29,4.36,4.30 in 1,3, 5% respectively. The data presented in Table 4.2 also, showed that the values of Titratable acidity (lactic acid %) was 0.96 in the control sample. This value lower than found in cheese sample processed by different levels of ginger powder 2, 4, 6% 2, 4, 6%, which were 1.22, 1.32, 1.44% respectively. This result higher when compared to [24], of Ayib sample treated with ginger powder which were 0.76, 0.79, 0.79 in 1, 3, 5% respectively. These result in line with those found by [25], which was 1.19%. Statistically, there are significant differences ($P<0.005$) between cheese sample in titratable acidity. The total solids content of the cheese sample was 54.90, 57.4, 58.27 and 59.33 in control l, 2, 4 and 6%, respectively and increased significantly ($P<0.005$). The highest total solids content was 59.33% and recorded in cheese sample produced by 6% of ginger powder and while the lowest one in the control sample which was 54. 90%. This is due to the addition of the powder increased total solids content in the cheese. Statistically, there is a significant difference ($P<0.005$) between cheese sample in total solids content.

Table 4: Physiochemical composition (%) of processed cheese with the addition of garlic powder.

Parameters	Control sample	Ratio		
		2%	4%	6%
Moisture%	45.10±0.09^{a}	38.50±0.12^{b}	37.50±0.15^{bc}	36.77±0.09^{c}
Protein%	16.18±0.07^{b}	15.31±0.12^{c}	17.06±0.10^{ab}	17.5±0.14^{a}
Fat%	26.61±0.52^{a}	25.58±0.12^{b}	25.30±0.43^{b}	25.18±0.45^{b}
Ash%	3.98±0.14^{c}	4.10±0.08^{b}	4.50±0.09^{ab}	4.77±0.08^{a}
pH	4.43±0.11^{d}	4.53±0.09^{c}	4.58±0.09^{b}	4.61±0.08^{a}
Titratable acidity	0.96±0.08^{d}	1.12±0.11^{c}	1.19±0.04^{b}	1.20±0.10^{a}
Total Solids%	54.90±0.10^{c}	61.50±0.90^{b}	62.50±0.11^{ab}	63.23±0.11^{a}

Mean values ± standard deviation having a different superscript letter(s) in each row differ significantly ($P<0.005$).

Minerals content of processed cheese by addition of ginger powder

The mineral contents of the control sample and different concentration of processed cheese by addition ginger powder are also shown in (Table 3). In processed cheese sample the concentrations of sodium (Na) the highest one was recorded in cheese sample produced by 2% of ginger powder which was 87.33mg/100 g. And while the lowest one in cheese sample produced by 6% of ginger powder which was 74.23mg/100g. These results are in line with those found by [19] which was 85.82. Statistically, significantly different ($P<0.005$) between cheese sample in concentrations of Sodium. The data presented in (Table 4&3) also, showed that the concentrations of potassium (K) in control sample was 83.33mg/100g higher than found in processed cheese by different levels of ginger powder 2, 4, 6% which were 58.33, 55.33, 54.33mg/100g in 2, 4 and 6%, respectively.

In a previous study, Garlic induced significant epigastric pressure, stinging, and warmth, while intensity of cramps, satiety, nausea, and pain was not significantly different to placebo. Garlic induced an immediate, short-lived fundic relaxation. No effect of allic in on proximal gastric mechanosensitive and compliance was observed [26].

These results were higher than those reported by [19] which was

16.50 Statistically, there are significant differences (P<0.005) between cheese sample in concentrations of potassium. The concentrations of Calcium (Ca) in a control sample which was 380.00mg/100g and 380.67, 378, 378.33 in 2, 4 and 6% respectively. In processed cheese by added ginger powder. These results were in line with those found by [19], which was 365.30. Statistically, significantly different (P<0.005) between cheese sample in concentrations of calcium.

The physicochemical composition of processed cheese by the addition of garlic powder

The chemical composition of processed white cheese with different concentrations of garlic powder (2, 4 and 6% g/g) is shown in (Table 4). The value of moisture content in control was 45.10%, this value higher than other found in cheese with 2, 4, 6% garlic which was 38.50%, 37.50%, 36.77%, respectively. Statistically, significant differences (P<0.005). In moisture content of different concentrations of garlic powder in cheese, samples were found, this result was lower than that reported by [23], which was 55.14% because the addition of powder decreases the moisture content in cheese. The data presented in (Table 4&4) also, showed that the protein content of cheese sample was 16.18, 15.31, 17.06 and 17.5% in control l, 2, 4 and 6%, respectively. There are significant differences (P<0.005). These results were in line with those found by [24], which was 18.22%. The fat content in control sample was 26.61%, this value higher than found in cheese sample processed by added garlic powder in ratio 2, 4 and 6% which were 25.58, 25.30 and 25.18%, respectively. These values are lower than that reported by [27], which was 29.33%. This study also showed no significant variation (P<0.005) between cheese samples in fat content. The ash content in control was 3.98% is lower than other cheese sample processed by adding garlic powder in ratio 2, 4 and 6% which were 4.10, 4.50, and 4.77%, respectively-statistically, significant variation (P<0.005) between cheese sample in ash content. On the other hand, the pH value in (Table 4). A control sample was 4.43 this value in close agreement with those in cheese with 2, 4, 6% garlic powder which was 4.53, 4.58, 4.61%, respectively. There is no significant differences (p>0.005) effect on the pH value of the samples. These results were in close agreement with those reported by [24], of Ayib sample treated with garlic powder which was 4.28, 4.28, 4.30 in 1, 3, 5%, respectively. The Titratable acidity was 0.96 in the control sample. This value is lower than that found in cheese sample processed by added garlic powder in ratio 2, 4, 6% which were 1.12, 1.19, 1.20%, respectively. These result in line with those found by [25] which was1.19%. Statistically, no significant difference (P<0.005) between cheese sample in titratable acidity. The total solids content of cheese sample was 54.90, 61.50, 62.50 and 63.23 in control, 2, 4 and 6%, respectively. Increased significantly (P<0.005). The highest total solids content was 63.23% and recorded in cheese sample produced by 6% of garlic powder and while the lowest one in control sample which was 54.90%, because the addition of the powder increased total solids content in the cheese.

Minerals content of processed cheese by added garlic powder

The mineral contents of the control sample and different concentration of processed cheese by adding garlic powder are shown in (Table 4&5). In processed cheese samples the concentrations of sodium (Na) in control sample was 83.33mg/100g this result higher than found in processed cheese by added garlic powder which were

Table 5: Minerals content (mg/100g) of processed cheese by added garlic powder.

Element	Control sample	Ratio		
		2%	4%	6%
Sodium (mg/100g)	83.33±0.04^{b}	70.67±0.12^{c}	75.00±0.33^{b}	77.33±0.23^{a}
Potassium (mg/100g)	60.00±1.73^{a}	50.33±0.23^{c}	53.67±0.32^{b}	53.33±0.45^{b}
Calcium (mg/100g)	361.00±0.33^{a}	240.33±0.34^{d}	320.66±0.44^{b}	310.00±0.34^{c}

Mean values ± standard deviation having a different superscript letter(s) in each row differ significantly (p<0.005).

Table 6: Microbial load of cheese processed by added different levels of ginger powder.

Parameters	Control sample	Ratio		
		2%	4%	6%
Total bacteria count	$8.30\times10^{3}\pm0.12^{d}$	$13.67\times10^{4}\pm0.11^{b}$	$16\times10^{3}\pm0.16^{c}$	$22\times10^{4}\pm0.12^{a}$
Mould and yeast	$9.67\times10^{2}\pm0.14^{a}$	$6.33\times10^{2}\pm0.09^{b}$	$5\times10^{2}\pm0.13^{c}$	$4.67\times10^{2}\pm0.14^{d}$
Coliform count	$2\times10^{2}\pm0.33^{a}$	ND	ND	ND
Salmonella	$1.68\times10^{2}\pm0.07^{a}$	ND	ND	ND

Mean values ± standard deviation having a different superscript letter(s) in each row differ significantly (p<0.005); ND: not detected.

70.67, 75.00, 77.33mg/100g in 2, 4 and 6%, respectively. The highest one was recorded in the control sample, which was 83.33 mg/100g, while the lowest one in 2% samples, which were 61.00mg/100g. The data presented in (Table 4&5) also, showed that the concentrations of potassium (K) in control sample was 60.00 mg/100 g higher than found in processed cheese by added garlic powder were 50.33, 53.67, 53.33mg/100g in 2, 4 and 6%, respectively. These results higher than reported by [19] which was 16.50, statistically, significantly different (P<0.005) between cheese sample in concentrations of potassium. The concentrations of calcium (Ca) in a control sample which was 361.00mg/100g. and 240.33, 320.66, 310.00 in 2, 4 and 6%, respectively. In processed cheese by added garlic powder. These results were in line with those found by [19], which was 325.30. Statistically, significantly different (P<0.005) between cheese samples in concentrations of calcium.

Gelatin hydrolysate was reported to contain large quantities of biologically active peptides with excellent antioxidant properties. Its inducement of antioxidant rejoinder within cells and the underlying molecular mechanism are far from clear. A previous study by [28] who reported that the gelatin from Nile tilapia skin was hydrolyzed by ginger protease to produce antioxidant hydrolysate, and three fish skin gelatin hydrolysate fractions were obtained by ultrafiltration.

Microbial load of cheese processed by added different levels of ginger powder

The results obtained from the microbiological analysis of cheese samples were shown in (Table 4&6). The Total Bacterial Count (TBC) of a control sample which was 8.30×10^{3} CFU/ml. While in processed cheese by added ginger powder which was 13.67×10^{4}, 16×10^{3}, 22×10^{4} cfu/ml in 2, 4 and 6% respectively. The highest total bacterial count was recorded in cheese sample produced by 6% of ginger powder and while the lowest one in control sample. These results were lower than those reported by [19], which were 15×10^{5}, 11×10^{5}, 9×10^{5} cfu/ml in 1, 3, 5% respectively. Statistically, significantly different (P<0.005) between cheese samples in total bacterial count. (Table 4&6) showed

Table 7: Microbial load of cheese processed by added different levels of garlic powder.

Parameters	Control sample	Ratio		
		2%	4%	6%
Total bacteria count	$8.30\times10^{3}\pm0.12^{b}$	$8.33\times10^{3}\pm0.12^{b}$	$8.46\times10^{3}\pm0.16^{b}$	$9.79\times10^{3}\pm0.11^{a}$
Mould and yeast	$9.67\times10^{2}\pm0.14^{a}$	$4\times10^{2}\pm0.09^{b}$	$3.67\times10^{2}\pm0.13^{c}$	$2\times10^{2}\pm0.13^{d}$
Coliform count	$2\times10^{2}\pm0.33^{a}$	ND	ND	ND
Salmonella	$1.68\times10^{2}\pm0.07^{a}$	ND	ND	ND

Mean values ± standard deviation having a different superscript letter(s) in each row differ significantly (*P*<0.005); ND: Not Detected.

Table 8: Effect of ginger and garlic power on consumer acceptability (Mean±SE) of white cheese samples.

Treatment	Overall	Texture	Taste	Flavour	Colour
Control	7.30^{c}	7.10^{cb}	7.40^{b}	7.50^{b}	8.10^{a}
Gi2	8.30^{b}	6.20^{d}	7.10^{cb}	7.30^{b}	7.00^{cb}
Gi4	7.30^{c}	7.30^{c}	7.40^{b}	6.30^{c}	7.00^{bc}
Gi 6	7.10^{c}	7.50^{b}	7.00^{c}	7.90^{ab}	6.90^{d}
Ga2	7.44^{c}	7.70^{b}	8.10^{a}	6.90^{cb}	7.60^{b}
Ga4	8.00^{b}	7.70^{b}	7.30^{b}	8.10^{a}	7.60^{b}
Ga6	9.30^{a}	8.10^{a}	7.99^{ab}	7.10^{b}	7.70^{ab}

that the yeast and moulds count was detected in all cheese samples. Control sample which was 9.67×10^{2} CFU/ml. While in processed cheese by different levels of ginger powder 2, 4 and 6% which were 6.33×10^{2}, 5×10^{2}, 4×10^{2} CFU/ml in 2, 4 and 6% respectively. The highest yeast and moulds count was recorded in the control sample. While the lowest one in cheese sample produced by 6% of ginger powder. These results lower than found by [23] which was 3.5×10^{6}. Statistical analysis showed that there were significant differences at (P<0.005) in yeasts and moulds. *Coliform bacteria* count detected in a control sample which was (2×10^{2} cfu/ml), while not detected in processed cheese by different levels of ginger powder. Due to addition ginger powder as antimicrobial in during cheese processing, while in previous studies there is growth *Coliform bacteria* was detected which was 2.23×10^{3} CFU/ml in [24]. *Salmonella* count in control sample which was 1.68×10^{2}, while not detected in processed cheese by different levels of ginger powder. Due to good pasteurisation of milk and addition ginger powder as antimicrobial in during cheese processing, while in previous studies there is detected growth of *Salmonella* was which was 12×10^{2} CFU/ml in [22].

Microbial load of cheese processed by added different levels of garlic powder

In Table 7, the total bacterial count of a control sample which was 8.30×10^{3} cfu/ml. While in processed cheese by added garlic powder which was 8.33×10^{3}, 8.46×10^{3}, 9.79×10^{3} CFU/ml. The highest total bacterial count was recorded in cheese sample produced by added 6% of garlic powder and while the lowest one in the control sample. These results were in line with those found by [19] which was 11×10^{3}. Statistically, no significant different (P<0.005) between cheese samples in total bacterial count. (Table 7) also, showed that the yeast and moulds count was detected in all cheese samples. Control sample which was 9.67×10^{2} cfu/ml higher than found in processed cheese by different levels of garlic powder 2, 4 and 6% which were 4×10^{2}, 3.67×10^{2}, 2×10^{2} cfu/ml in 2, 4 and 6%, respectively. These results were lower than reported by [24], of Ayib sample treated with garlic powder which was 8.01, 6.32, 7.32×10^{2} in 1, 3 and 5%, respectively. Statistical analysis showed that there were significant differences at (P<0.005) in yeasts and moulds. *Coliform bacteria* count was detected in control sample which was (2×10^{2} cfu/ml), while not detected in processed cheese by different levels of garlic powder, due to add garlic powder stopped growth of *Coliform bacteria*, but in some previous studies the growth of *Coliform bacteria* was detected which was 2.14 ,1.09×10^{3} CFU/ml in [24]. *Salmonella* count in control sample which was 1.68×10^{2}, while not detected in processed cheese by different levels of garlic powder. Due to good pasteurisation of milk and addition, garlic powder killed *Salmonella* count, while in previous studies there is detected growth of *Salmonella* was which was 12×10^{2} CFU/ml in [22].

Sensory evaluation

Sensory evaluation of the white cheese samples was affected by the type and level of spice powder are presented in (Table 4.8). Comments given by the panellists showed a preference for a product which has good on the colour, flavour, taste, texture and overall acceptability were significantly different (P<0.005) among of cheese samples. The highest colour score in control sample while the lowest one was recorded in cheese sample with 6% ginger powder. The addition of a different level of garlic and ginger powder affected the flavour of white cheese samples. The highest flavour scores were obtained in cheese sample with 4% garlic powder and the lowest one in cheese sample with four % ginger, with significant differences (P>0.005). Taste of white cheese samples, the highest score was obtained in 2% garlic powder while the lowest one in 6% ginger powder, with significant differences (P>0.005)-the effect of garlic and ginger powder on the texture of cheese samples. The highest texture score of white cheese samples was recorded in 6% garlic powder while the lowest one in 2% ginger powder, with significant differences (P>0.005).

The consumer acceptability means values ranged from 9.30 to 7.10 (Table 4&8), white cheese samples with 6% garlic had the highest overall consumer acceptability score and the lowest one in white cheese samples with 6% ginger. This result is in line with the report of [24,29,30]. Who revealed that Ayib samples treated with 5% garlic were more favoured than samples treated with 5% ginger. Samples produced by 6% ginger powder received significantly (p<0.005) low mean scores for all the sensory attributes considered.

Conclusion

The present study confirms the possibility of production of cheese by of adding garlic and ginger powder. The manufactured cheese was analyzed chemically, microbiologically and subjected to sensory analysis. Understanding the effects of locally available spices, particularly garlic and ginger, on the microbial and biochemical properties as well as on consumer acceptability, is essential in improving traditional fermented milk products. Although there are numerical variations in fat, ash, moisture, protein, pH, and a total solids content of white cheese produced by adding garlic powder and ginger powder compared with the control samples, increasing treatment inclusion levels did not affect the fat and ash. The natural antimicrobial agents in the garlic and ginger might stop the growth of *salmonella* and *Coliform bacteria*. White cheese samples with 6%

garlic powder received the highest consumer acceptability scores compared with other treatments. Fresh soft white cheese made by addition of garlic and ginger powder is most acceptable.

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