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APPLICATION OF GALLIC ACID IN THE MANUFACTURING OF CHANNA CHEESE

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Abstract

This study was used Gallic acid in manufacture of channa cheese as a coagulant and preservative of three concentrations (0.1, 0.2 and 0.3 mg / ml) with a control sample made of citric acid, Sample were storage for different periods, Many tests were counted including microbiological, chemicals tests and statistical analysis of sensory evaluation. Microbiological tests showed that the total count bacterial in the sample containing the highest concentration of Gallic acid (0.3mg / ml) was 1.8, free coliform bacteria, psychrophilic bacteria, mold and yeast was better than the other samples, In addition chemical tests as the percentage of protein and fat and yield was 12.75%, 8.81% and 15.2% respectively. The results revealed that there was no significant differences ($p<0.01$) between control and the sample containing highest concentration of Gallic acid of flavor, texture, pores, cohesiveness, bitterness except color there was signification differences ($p<0.01$).

Key words: Gallic acid, manufacture, Channa cheese.

Introduction

Gallic acid organic acid known as Trihydroxybenzoic acid 3,4,5 Chemical formula has H_2 $(OH)_3COOH$ C_6 is found in a variety of foods and herbs (Raghu *et al*., 2016). Gallic acid is produced in different ways, including the industrial and biological by microbial fermentation and producing the tannase which degrades tannin into Gallic acid and glucose. In this study, Gallic acid production from local isolate bacteria *Bacillus subtilis* HEP13A2 using agricultural and food waste as an economic source of tannin. Studies have shown that Gallic acid is one of the most bioactive compounds for its many activities such as antimicrobial, antifungal, antiviral, antioxidant, anticancer, (Raghu *et al*., 2016). Serrention *et al*., (2018) used Gallic acid to save the black truffles for a longer time by inhibiting the pathogenic bacteria *Pseudomonas flourcens*. Did not appear strange tests and the truffles were maintained during the period of storage. Gallic acid used by Valle *et al*., (2018) in the inhibition of *Leuconostoc* Bacteria cause meat damage and also prevented the discoloration of meat by lactic acid bacteria LAB. Due to the properties of Gallic acid used in the cheese industry and to save it longer than usual by inhibiting the microbes that cause cheese damage. Gallic acid was applied in the manufacture of channa cheese, one of the types of soft cheeses manufactured by heating the milk and then adding amount of lemon to coagulation, Whey was removed without pressure and added amounts of salt suitable and uses this type of cheese in the preparation of different types of sweets in India (Al-Dahan, 1983).

Materials and Method's

Sample collection

Whole cow's milk was obtained from the dairy factory of Department of Food Science Collage of Agricultural Engineering Sciences at University of Baghdad. Sample were collected in the sterilized glass bottles and immediately brought to the laboratory for analysis.

Analysis of milk Chemical

The Chemical composition of milk was determined by different parameters like Protein%, Fat%, Total Solid%, Acidity% and Specific Gravity. Protein % was determined by Micro-Kjeldahl and the Gerber's method was used for the determination of fat% of milk (Ling, 1963). Total solid contents of milk were determined by oven dried method, the acidity of milk can be determined by acid base titration and Lactometer was used for the determination of specific gravity of milk (Fahmid *et al*., 2016).

Manufacturing of channa cheese

channa Indian cheese was manufactured according to the method described by Al-Dahan, (1983) with some modifications by the researcher, The milk was heat-treated then added amounts of Gallic acid instead of citric acid in three concentrations (0.1, 0.2 and 0.3 mg/ml) separately, With the control sample citric acid is added only in concentration (0.3 mg/ml), after the coagulation left for 5 minutes and the whey was Removed, then filled in molds and left for a while and then kept in the refrigerator. The microbiological, chemicals tests and sensory properties were tested.

Microbiological tests

Sample homogenate was prepared using 25 g of each sample taken from three different pieces avoiding the surface into pre-sterilized bag and 225 ml of 2% sodium citrate dilution buffer at 40°C-45°C was added (Haddad *et al*., 2017). Appropriate serial dilutions were made. The samples were examined for total bacteria count, coliform count, yeast and molds count and psychrophilic counts. All media were obtained in dehydrated forms and they were prepared according to the manufactures instruction. Plate count agar was used for the total bacteria count and psychrophilic count. Nutrient agar (Himedia), MacConkey agar (Accumix) is a selective differential media used for coliform counts and Potato Dextrose Agar (Macrogen) was used for enumeration of yeast and molds. Sterilization, preparation of the samples, serial dilution, incubation and counting were done according to Harrigan and MacCance (1976).

Chemical tests of channa cheese

The acidity, moisture, ash, fat (using the Gerber's method), protein using (Micro-Kjeldahl method) contents of all treatments channa cheese samples were determined according to the methods described by Ling (1963). The pH values of all cheese samples were also measured by using a pH meter (Saldamli and Topçu,2007) and total solid measured by oven dried method (Fahmid *et al*., 2016).

Sensory evaluation of channa cheese

The sensory evaluation tests of the channa cheese samples were conducted in the Department of Food Science, Faculty of Agricultural Engineering Sciences, University of Baghdad, by a number of specialist professors accordinghto the sensory evaluation format which included the characteristics of flavor, texture, color and appearance using the 10-degree system used by researchers Al-Darwash, (1982), Nader, (1994) and Janabi, (1995).

Table 1: Percentages some of the basic components of milk.

Value	Components
2.8	Fat
3.2	Protein
0.18	Acidity
6.3	pH
1.58	Total solids
0.90	Specific weight

Statistical analysis

SAS-Statistical Analysis System (2012) program was adapted on-LSD to compared between control treatment and other treatment.

Results and Discussion

Milk analysis

Table 1, shows percentages of protein, fat, acidity and total solids and pH in addition to Specific Gravity of milk used in the manufacture of soft channa cheese.

Microbiological testing of the soft channa cheese

• Total bacterial count: Table 2, shows The total bacterial count increase in the control sample during the periods of storage higher than total bacterial count of three samples of cheese samples treatment with Gallic acid. An indication of the Inhibition activity of Gallic acid against bacteria. In addition to not exceeding samples as well as control sample of acceptable limits to the Iraqi specifications, may be due to the factor of clotting (Gallic acid) and of the results of table (1-2) tool to improve the shelf life of channa cheese. Total bacterial count in the control sample on the first day was 2.6×10^2 CFU/g while first treatment with Gallic acid at a concentration of was (0.1mg/ml) 1.9×10^1 CFU/g, second treatment (0.2mg/ml) 1.5×10^1 CFU/g and third treatment (0.3mg/ml) 1.1×10^1 CFU/g. On fifth day total bacterial count in the control sample was 2.1×10^3 c.f.u/g, first treatment with Gallic acid 4.1×10^2 CFU/g, while second and third treatments 1.7×10^2 CFU/g 1.2×10^2 CFU/g respectively. Total bacterial count increased on tenth day of the storage period. The total bacterial count in the control sample was more compared with Gallic acid treatments.

10^4 CFU/g,× It was in the control sample1.1

First treatment with Gallic acid 1.8×10^3 CFU/g while second and third treatments was lower as the total

Table 2: Total bacterial count CFU/g channa.

Storage period (days)			Treatment
10	5	1	Mg / ml
$10^4 \times 1.1$	$10^3 \times 2.1$	$10^2 \times 2.6$	Control
$10^3 \times 1.8$	$10^2 \times 4.1$	$10^1 \times 1.9$	0.1
$10^3 \times 3.1$	$10^2 \times 1.7$	$10^1 \times 1.5$	0.2
$10^2 \times 1.8$	$10^2 \times 1.2$	$10^1 \times 1.1$	0.3

bacterial count reached 3.1×10^2 and 1.8×10^2 CFU/g. The reason may be of the decomposition of protein and fat allow the growth of some types of microorganisms and may have some adaptation of the bacteria to resist active substances because of consumption or the development of a specific defense mechanism due to the increase in the storage period (Jakobsen and Narvhus, 1996). In channa cheese total bacterial count did not exceed allowable limit (10^8) according to the specifications approved by the Organization for Standardization and Quality Control (Central Organization for Standardization and Quality Control, 1988), Ahmed *et al*., (1994) reference that total bacterial count increased during the storage period without indicating a sudden decrease in the total bacterial count at the end of the storage period. The Central Organization for Standardization and Quality Control (1988) remind that the shelf life of Iraqi soft cheese is one week.

Coliform bacterial count

The results of table 3 shows that the first treatment with galic acid 0.1 mg / ml and the second 0.2 mg / ml did not exceed the allowable limit number of Coliform bacteria during storage periods according the Iraqi standards specifications (Central Organization for Standardization and Quality Control 1988), the third treatment 0.3 mg / ml free coliform bacteria during the experiment and this refers to the manufacture of soft channa cheese from Gallic acid (the highest concentration). It is preserved longer and gives it safe to consume because it is free of Coliform bacteria, Coliform bacteria in the control sample was higher than the treatments on the fifth day of storage of 1.2×10^3 CFU/g. In the treatment of (0.2) mg / ml 1.7×10^1 CFU/g, treatment with a concentration of (0.3) mg/ml Gallic acid seems to inhibit the growth of *E. coli* bacteria and this confirms we found it in our experiment on the Effective inhibition against *E. coli*, which was the most sensitive to Gallic acid Other bacterial isolates tested. in the storage period tenth days increased Coliform bacteria in all treatments but in the control sample was the highest of other treatments reached 2×10^3 CFU/g. This is contrary to the Iraqi standard specifications (1988), which states that the acceptable number of coliform bacteria 1×10^3 c.f.u/g, it is explains that coliform bacteria are already present in the milk from which cheese is manufacture, they are known to be the main contaminants of milk and remain in milk products even after processing and preservation, but in a few numbers did not allow it to grow, but after increasing the Storage period began to grow (Eissa *et al*., 2011), which is less than the Al-Dahan found (1983) in the Iraqi soft cheese produced at the College of Agriculture/University of Baghdad where the number was 10^5 CFU/g and also found Sajeet (2010) in soft cheese available in the Iraqi market, reaching 1.7×10^6 CFU/g. Alundawi, (1977) confirmed that the coliform bacteria in white cheese increases continuously within a week of storage without decrease at the end of storage period.

Table 3: Coliform bacterial count (CFU /g) in channa cheese.

Storage period (days)			Treatment
10	5	1	Mg / ml
$10^3 \times 2$	$10^3 \times 1.2$	$10^2 \times 1.9$	Control
$10^2 \times 8$	$10^2 \times 3.4$	$10^1 \times 1.8$	0.1
$10^2 \times 1.2$	$10^2 \times 1.7$	$10^1 \times 1.2$	0.2
0	0	0	0.3

Table 4: Psychrotrophic bacteria count (CFU/g) in channa cheese.

Storage period (days)			Treatment
10	5	1	Mg / ml
$10^3 \times 1.2$	$10^3 \times 1$	$10^2 \times 4$	Control
$10^2 \times 1$	0	0	0.1
$10^1 \times 1.5$	0	0	0.2
0	0	0	0.3

Psychrotrophic bacterial count

Table 4 shows that psychrotrophic bacterial count developing in the cold has increased in the control sample from 4×10^2 CFU/g on the first day to 1×10^3 and 1.2×10^3 CFU/g for the two peroids fifth and tenth days respectively. The Gallic acid-treated samples of the three concentrations and for the storage peroids first and fifth days was free psychrotrophic bacteria. Evidence of Gallic acid Effective inhibition against psychrotrophic bacteria, On the tenth day of storage psychrotrophic bacterial count in the control sample was more than the acid-treated. Psychrotrophic bacterial count for the first treatment (0.1 mg/ml) 1×10^2 CFU/g, second treatment (0.2 mg/ml). Non growth in the highest concentration of Gallic acid (0.3 mg/ml) indicates that the use of Gallic acid instead of citric acid in the manufacture of this type of soft cheese contributed to the Inhibition of growth psychrotrophic bacteria and the effect increases with concentration.

Mold and yeast count

Table 5 shows mold and yeast count of soft cheese was high in the control sample as the numbers reached

Table 5: Mold and yeast count in channa Soft Cheese.

Storage period (days)			Treatment
10	5	1	Mg / ml
$10^3 \times 3.1$	$10^3 \times 2.7$	$10^3 \times 2$	Control
$10^2 \times 5$	$10^2 \times 1.6$	$10^2 \times 3.4$	0.1
$10^1 \times 3$	$10^1 \times 1.4$	0	0.2
0	0	0	0.3

Table 6: The chemical composition of the soft channa.

pH	Yield %	Total solids %	Ash %	Protein %	Fat %	Moisture content %	Treatment Mg/ml	No.
5.58	12.01	45.26	0.88	12.28	8.14	54.74	Control	1
5.91	9.73	42.76	0.94	12.96	8.41	57.24	0.1	2
6.02	15	45.62	1.01	12.90	8.33	54.38	0.2	3
6.19	15.2	47.58	0.95	12.75	8.81	52.92	0.3	4

on the first day of storage 3.1×10^3 CFU/g. Mold and yeast count increased in periods 5 and 10 days to 2.7×10^3 CFU/g, 3.1×10^3 CFU/g respectively. The sample cheese treated 0.1 mg/ml Gallic acid also increased the numbers with storage period to the tenth day to 5×10^2 CFU/g and a sample concentration of 0.2 mg/ml increased to 3×10^1 spore/g, these numbers are less than the Iraqi standard specifies that the number of yeast and mold 1×10^1 spore/g soft cheese (Central Organization for Standardization and Quality Control, 2006), As correspond to Jabbar, (2013) found in soft Ashaar cheese 3×10^2 spore/g cheese for our control treatment and higher than the Gallic acid treatments and less than found Sajeet, (2010) in soft cheese in Baghdad markets 8×10^5 spore/g, However, the third treatment sample 0.3 mg/ml Gallic acid was free mold and yeast in the three storage periods.

Chemical tests of soft channa cheese

The result of table 6 shows that the moisture content in cheese samples ranged between 52.42 to 57.24%. These correspond to the Iraqi Standard specifications for Soft Cheese (Central Organization for Standardization and Quality Control, 1988). That the moisture content is more than 50% and the results showed the percentage of fat between 8.14-8.81% and this range is contrary to the Iraqi standard specifications have percentage fat not less than 16% + 1 (Central Organization for Standardization and Quality Control, 1988). However, the highest value was the highest concentration of Gallic acid in the cheese industry and compared with the control sample the percentage of fat was lower than the three Gallic acid samples were 8.14%. The same table shows the percentage of protein in the soft channa cheese samples between 12.28 - 12.75% and the percentage of ash was between 0.88 - 1.01%.

The yield of cheese was calculated for the control sample (12.01%). Samples treated with Gallic acid 9.73%, 15% and 15.2% respectively from the lowest concentration of 0.1 mg/ml to the highest concentration of 0.3 mg/ml. There is a difference in the yield between three samples of treatments cheese with Gallic acid according to the added concentration. The yield correspond of soft cheese made by coagulated proteases and product from local isolate *Bacillus subtilis*. And soft cheese made by coagulated proteases (*Mucor miehei*) (14.9% and 15.6%, respectively) (al-Janabi, 1995). As the concentration of Gallic acid increases moisture content decreases and the yield increases.

Sensory Calendar of Cheese

Data shown in table 7 indicate that, sensory evaluation of the soft channa cheese was manufacturing by Gallic acid with concentrations of 0.1 - 0.3 mg/ml. The flavor found significant differences in the first sample treated (0.1 mg/ml) Gallic acid and there are no significant differences with the second and third samples treated (0.2, 0.3 mg/ml) Gallic acid, Texture, Pores, Cohesiveness There were significant differences in the first and second samples and no differences in the third sample comparison with control sample. Color no significant differences in the first and second samples, but there are differences in the third sample comparison with control sample and showed the results of statistical analysis of bitterness there are no significant differences in the three samples treated with Gallic acid comparison with control sample.

Table 7: The results of the sensory evaluation of cheese Channa.

Mean ± standard deviation						Treatment mg/ml
Bitterness	Color	Cohesiveness	Pores	Texture	Flavor	
±10.00 a 0.00	± 9.37 a 1.76	± 10.00 a 0.00	± 10.00 a 0.00	± 9.37 a 1.76	± 10.00 a 0.00	Control
± 10.00 a 0.00	± 8.75 ab2.31	± 0.62 c 1.06	± 1.87 c 0.45	± 1.25 c 1.03	± 4.37 c1.03	0.1
± 10.00 a 0.00	±10.00 a 0.00	± 5.00 b 2.67	± 6.78 b 2.58	± 5.62 b 3.0	± 8.12 a 2.85	0.2
± 10.00 a 0.00	± 7.50 b 2.67	± 10.00 a 0.00	± 10.00 a 0.00	±10.50 a 0.00	± 10.00 a 0.00	0.3
NS 0.00	**1.810	**1.641	**2.081	**2.217	**1.604	LSD

The averages with different letters within the same column vary significantly between them **: NS, (P <0.01) is insignificant.

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