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EFFECT OF ADDING DIFFERENT CONCENTRATIONS OF TURMERIC POWDER ON THE CHEMICAL COMPOSITION, OXIDATIVE STABILITY AND MICROBIOLOGY OF THE SOFT CHEESE

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Abstract

In this study, the influence of turmeric powder on the chemical composition, oxidative stability, and microbiological of the soft cheese was evaluated. Different concentrations of turmeric powder (0, 0.1, 0.2 and 0.3%) represented as (T1, T2, T3 and T4) were added to the milk processed to the soft cheese and then the cheese produced were stored in 5±2ºC for 9 days. The results showed that there was no significant differences between the cheese of the different treatments (T2, T3 and T4) and control cheese (T1) for moisture, protein, fat, ash and pH. Sensory evaluation of the cheese showed that there were no significant differences between the cheese treated with turmeric powder (T2, T3 and T4) and control sample (T1) for the color, texture and bitterness. While for the flavor, the results showed that there was a significant difference between cheese samples treated with turmeric powder 0.3% (w/ v) (T4) and the untreated cheese sample (control) (T4). The results of PV and AV recorded that the cheese treated with different concentrations of turmeric powder was lower ($p>0.05$) than untreated cheese (control). The microbiological results indicated that as the concentration of the turmeric powder increased the total bacterial count decreased compared with control treatment which showed the highest total count after 9 days of storage at 5±2 ºC. However, the Coliform bacteria were increased during storage for control treatment only while it was undetectable for T2, T3 andT4 treatments after storage at 5±2 ºC for 9 days. It could be concluded that turmeric powder could successfully use to improve the keeping quality of soft cheese.

Keywords: turmeric powder, soft cheese, antioxidants, antimicrobial.

Introduction

Plant derived spices have been utilized around the globe for many centuries not only for their flavor and aroma, but besides for their ability to enhance the shelf life of foods and for diverse medical treatments (Elžbieta *et al*., 2008; Yanishlieva-Maslarova, 2001). Spices are being tried for their medicinal value as antioxidants and as antimicrobials (Frankel *et al*., 1996; El-Ghorab *et al*., 2010). *Curcuma longa* is a medicinal plant that belongs to the *Zingiberaceae* family (Chattopadhyay *et al*., 2004). Turmeric, which is regarded as a spice may provide health benefits and have been proven to counteract oxidative stress (Modak *et al*., 2007). Turmeric powder came from the rhizome of *Curcuma. longa*, is commonly used as a spice, food preservative, and food coloring agent, (Aggarwall *et al*., 2007; Di Mario *et al*., 2007; Menon and Sudheer, 2007). The chemical composition of Turmeric is: 69.4% carbohydrates, 5.1% lipids, 2.6% fiber, and 6.3% proteins (Kamal & Yousuf, 2012). In addition, Turmeric is rich in minerals such as calcium, iron, phosphorus, and vitamin A. (Hossain & Ishimine, 2005). Turmeric has a polyphenols which named (curcuminoids), this include: Curcumin diferuloylmethane, demethoxycurcumin, and bisdemethoxycurcumin. Both of demethoxycurcumin and bisdemethoxycurcumin have antioxidant properties while curcumin has both antimicrobial and antioxidant properties. Curcuminoids are considered as the most bioactive and it has been diagnosed as a group of bis-α, β-unsaturated β-diketone polyphenols; namely curcumin (72%), desmethoxycurcumin (DMC) (12%), and bisdemethoxycurcumin (BDMC) (3%) (Krishnakumar *et al*., 2015). Hosny and others (2011) studied the antimicrobial activity of Curcumin upon pathogenic microorganisms during manufacture and storage of a novel style cheese 'Karishcum.

A recent trend in cheese manufacture is production of nature flavored cheese made in short time with high nutrient value and good microbiological quality as for human consumption, (Hussein., 2004 and Foad *et al*., 2006). Thus, the present work was conducted using Turmeric in the preparation of soft cheese to study the potential of turmeric as antibacterial and antioxidant agent during manufacture and storage of cheese.

Materials and Methods

Materials

Fresh Cow 's milk was purchased from the local market of Al- Najaf province. While turmeric (*Curcuma longa*) rhizomes were purchased from the local market of Baghdad province. The turmeric rhizomes were ground into powder using a coffee grinder.

Methods

Cheese Making

The cheese was prepared according to the method reported by (Talib 2006 and Talib, 2009) with little alterations. Fresh cows' milk was heated at 72 □C for 15 second and then cooled to 45 □C. The milk was separated into four Containers. Different concentrations of turmeric powder (0, 0.1, 0.2, and 0.3)% turmeric powder (w/ v) were added respectively to the containers and mixed well. Microbial rennet was added to the milk. The milk was mixed and left until coagulation. After coagulation the curd was cut vertically and horizontally into 5 cm^3 using a sharp knife. The whey obtained from the cheese curd was drained and the curd was pressed for each treatment separately. Then the cheese was placed in plastic containers, sealed and stored at 5°C ± 2.

Microbiological Analysis

Ten g sample was taken from cheeses at the age of 0, 3, 6 and 9 days, then homogenized in sterile 90 ml of 0.1% peptone water. Serial 5 fold dilutions in sterile 0.1% peptone water were prepared for bacterial analysis. The total bacterial

count was detected using the Nutrient Agar Medium, provided from (Hodeida –India), one ml of the previously prepared decimal dilutions were inoculated into duplicate plates of nutrient agar and incubated at 37 ºC for 24 hours (ISO 2006).

While MacConky Agar Medium provided from (Hodeida –India) which used to detect the *Escherichia coli* O157:H7 M 17, one ml of the previously prepared decimal dilutions were inoculated into duplicate plates of MacConky agar and incubated at 37 °C for 24 hours (ISO 2006).

Chemical Analysis

The chemical analysis of the cheese samples includes the following tests: the moisture content of the cheese samples was determined according to Egan and others (1985).The oil content in the cheese samples was tested depending on the method described by Eckles and others (1997) while the protein content was obtained using the Kjeldahal method as mentioned by Jolyn (1970). Ash content was determined on the cheese sample according to AOAC (1990). The pH value was measured using a digital pH meter (Ling, 1956). While Acid value of extracted lipids was determined according to AOAC [2007, method, 969.17]. However, the Peroxide value (PV) of extracted lipids was determined according to the method mentioned by Egan and others (1981).

Sensory Evaluation

Judges (males and females) were randomly selected and identified themselves as students and faculty of Food Science, Al–Kufa University, to evaluate the color, flavor, texture and bitterness of the cheese samples.

Statistical Analysis

A statistical analysis of the obtained results was performed using SAS [2004] software. Analysis of variance (ANOVA) with Duncan's multiple range test at a significance level of $P < 0.05$, a protected least significant difference test (LSD) was used to compare treatment means.

Results and Discussion

Table (1) illustrated the chemical compositions of the control cheese (T1) and the cheese with three concentrations of turmeric powder 0.1% (w/v) (T2), 0.2% (w/v) (T3), and 0.3% (w/v) (T4) after manufacturing directly. The results of statistical analysis showed no significant differences in the probability level of 0.05 between the cheese of the different treatments (T2, T3 and T4) and control cheese (T1) for moisture, protein, fat, ash and pH. The percentages of the components were among the values found by El- Diam and El-Zubier (2010) for the soft cheese manufacturing in Sudan.

The sensory evaluation was performed by participants for the cheese with varying concentrations of turmeric powder. The results of Table (2) indicated that there were no significant differences between the treated cheese samples (T2, T3 and T4) and untreated cheese sample (control) (T1) for the color, texture and bitterness. These results indicated that adding a turmeric powder to the milk processed into cheese did not affect the color, texture and bitterness attribute of the cheese samples. However, for the flavor, the results showed that there was a significant difference between cheese samples treated with turmeric powder 0.3% (w/ v) (T4) and the untreated cheese sample (control) (T4). The lower flavor score of the T4 may be due to the high concentration of turmeric powder which gave a different flavor to the cheese. In addition, Table (2) indicated that there were no significant differences between treatment T1, T2 and T3 and also there was no significant differences between the treated samples with varying concentrations of turmeric powder (T2, T3 and T4). Hosny and others (2011) reported that Karish cheese with Curcumin (Karishcum) gave the highest score comparing with Karish cheese (control) during storage period. During the cold storage period, the flavor and taste of Karishcum cheese samples were not markedly changed, while the flavored and taste of the control cheese samples was slightly got changed after 14 days.

Table (3) illustrated the effect of adding varying concentrations of turmeric powder to the milk processed to the cheese on the peroxide value (PV) of the extracted oil during 0,3,6 and 9 days of storage at 5±2 ºC. The results indicated that the PV increased significantly as the storage time increased for all treatments. The PV for the T1, T2, T3 and T4 increased from 0.61, 0.61, 0.61, and 0.61 meq/ kg at 0 day to the 0.79, 0.74, 0.70 and 0.69 meq/ kg respectively after 9 days of storage at 5±2 ºC. Also the results showed that the PV of the cheese treated with different concentrations of turmeric powder was lower ($p>0.05$) than untreated cheese (control). As the turmeric powder increased the PV decreased significantly. This result expected since the turmeric powder has a lot of phenolic compounds which consider as an antioxidant (Chattopadhyay and others, 2004;). Abd El-Aziz and other (2012) found that The PV of ginger extract-fortified cheese was lower ($p>0.05$) than control cheese that because of the rhizome of ginger contains curcumin in addition to many of phenolic compounds, which have antioxidant effect (Langner *and other* 1998).

Table (4) showed the effect of adding varying concentrations of turmeric powder to the milk processed to the cheese on the AV of the extracted oil from the cheese. The results showed that the AV increased significantly as the storage time increased for all treatments. The AV increased from 0.54, 0.54, 0.54 and 0.54 for T1, T2, T3 and T4 at 0 day of storage at 5±2 °C to the 0.73, 0.66, 0.65 and 0.61 respectively after 9 days of storage at 5±2 °C. In addition, Table (4) indicated that as the concentration of the turmeric powder increased the AV decreased significantly. The result obtained in this study was in agreement with the result obtained from Khalifa and Wahdan (2015) who found that the cheese samples treated with dehydrated cranberry fruit extract powder had showed lower significantly ($P \leq 0.05$) in total volatile fatty acids content than the control cheese samples. The main agents responsible for lipolysis are the natural lipase of milk, moulds and lactic acid bacteria, which have little activity.

Table (5) showed the effect of adding different concentrations of turmeric powder to the milk processed to the cheese on the total bacterial count during storage at 5±2 ºC. The result indicated that the total count increased during the storage for all treatments. The total bacterial count for T1, T2, T3 and T4 increased from 32×10^3, 31×10^3, 32×10^3, 32×10^3 CFU/g at 0 day of storage to the 93×10^4, 96×10^3, 82×10^3, 74×10^3 CFU/g respectively after 9 days of storage at 5±2 ºC. Moreover, the result indicated that as the concentration of the turmeric powder increased the total bacterial count decreased compared with control treatment

which showed the highest total count after 9 days of storage at 5±2 ºC. The total bacterial count decreased from 96×10^3 CFU/g for T2 to the 82×10^3 CFU/g for T3 and 74×10^3 CFU/g for T4 after 9 days of storage at 5±2 °C compared to the control treatment (T1) which recorded the highest total (93×10^4) CFU/g . These results expected since the turmeric powder has antibacterial action which inhibits the growth of some bacteria. Hosny and others (2011) reported that addition of aqueous Curcumin extract to the Karishcum cheese achieved a reduction of bacterial counts about one log of *Salmonella typhimrium* and two log of *Pesudomonas auroginosa* respectively. Meanwhile, both of *S. aureus*, *B. cereus* and *L. monocytogenes* were vanished at the end of cold storage period (14 days). Murad (1998) observed that some natural aqueous extracts had antimicrobial activity upon a wide variety of yeasts (*Kluyveromyces marxianus, **Kluyveromyces lactis**, Candida lipolytica, C. utilis, Hansenula anomala, Aspergillus niger, A. Ochraceus* and *A. fumigatus),* and bacteria (*Bacillus polymyxa , B. thuringiensis* and *B. subtilis*).

Table (6) illustrated the effect of adding varying concentrations of turmeric powder to the milk processed to the cheese during storage at 5±2 °C. The results indicated that the Coliform bacteria were increased during storage for control treatment only which was increased from 1×10^1 CFU/g at 0 day of storage to the 6×10^2 CFU/g after 9 days of storage at 5±2 °C. However, the coliform bacteria were undetectable for T2, T3 andT4 treatments after storage at 5±2 °C for 9 days. This might be due to the effect of turmeric powder on coliform bacteria. The result obtained from this study was in agreement with the result obtained by Hosny and others (2011) who found that Coliform bacteria count was not detected in the Karishcum cheese sample made by adding *Curcuma. Longa* (Curcumin or Turmeric) at the end of cold storage period.

Table 1: Effect of adding different concentrations of turmeric powder on the Chemical Composition of cheese.

Test Treatment	Moisture %	Protein %	Fat %	Ash %	pH
T1	60.04 a	15.48 a	16.46 a	4.09 a	6.5 a
T2	59.96 a	15.51 a	16.48 a	4.11 a	6.5 a
T3	60.07 a	15.46 a	16.45 a	4.06 a	6.5 a
T4	59.92 a	15.54 a	16.49 a	4.15 a	6.5 a

Mean carrying same letters in a Column are not significant differences

Table 2 : Effect of adding different concentrations of turmeric powder on the Sensory Evaluation of cheese.

Attributes Treatment	Color	Flavor	Texture	Bitterness
T1	9.00 a	8.50 b	8.75 a	10.00 a
T2	9.25 a	8.25 ab	9.00 a	10.00 a
T3	8.50 a	7.75 ab	8.75 a	10.00 a
T4	8.50 a	7.00 a	8.50 a	10.00 a

Mean carrying same letters in a Column are not significant differences

Table 3 : Effect of adding different concentrations of turmeric powder on the peroxide Value (PV) of the cheese during storage.

Test/ days Treatment	PV (meq/ kg)			
	0 day	3days	6 days	9 days
T1	0.61	0.69	0.73	0.79
T2	0.61	0.66	0.70	0.74
T3	0.61	0.65	0.68	0.70
T4	0.61	0.63	0.67	0.69

Least significant differences of means (LSD) (5% level) were as follows: LSD for treatment was 0.029 and LSD for day was 0.029

Table 4 : Effect of adding different concentrations of turmeric powder on the Acid Value (AV) of the cheese during storage.

Test/ days Treatment	AV			
	0 day	3days	6 days	9 days
T1	0.54	0.58	0.65	0.73
T2	0.54	0.56	0.62	0.66
T3	0.54	0.56	0.60	0.65
T4	0.54	0.55	0.58	0.61

Least significant differences of means (LSD) (5% level) were as follows: LSD for treatment was 0.033 and LSD for day was 0.033

Table 5 : Effect of adding different concentration of turmeric powder on the total count bacteria in the cheese during storage time.

Test/ days Treatment	Total connt bacteria CFU/g			
	0 day	3 days	6 days	9 days
T1	32×10^3	88×10^3	41×10^4	93×10^4
T2	31×10^3	49×10^3	73×10^3	96×10^3
T3	32×10^3	43×10^3	61×10^3	82×10^3
T4	32×10^3	41×10^3	59×10^3	74×10^3

Table 6: Effect of adding different concentrations of turmeric powder on the total Coliform bacteria in the cheese during the storage time.

Test/ days Treatment	Total coliform bacteria CFU/g			
	0 day	3 days	6 days	9 days
T1	1×10^1	2×10^1	2×10^2	6×10^2
T2	1×10^1	N.D	N.D	N.D
T3	1×10^1	N.D	N.D	N.D
T4	1×10^1	N.D	N.D	N.D

References

A.O.A.C. (1990). Association of official Analytical chemists. Official methods of analysis 15th Edn. Washington, DC., USA.

Abd El-Aziz, M.; Sahar, H.S. and Seleet, F. (2012). Production and Evaluation of Soft Cheese Fortified with Ginger as a Functional Dairy Food. Pol. J. Food Nutr. Sci : 62(2): 77-83.

Aggarwal, B,B.; Sundarma, C.; Malani, N. and Ichikawa, H. (2007). Curcumin :the Indian solid gold Adv. Exp. Med. Biol., 595: 1-75.

AOAC, Association of Official Analytical Chemists. Official Methods of Analysis. 2007, 18th Ed., Chapter 33, pp. 75, 79, 82, 85, Benjamin Franklin Station Washington, D.C., USA.

Chattopadhyay, I.; Biswas, K.; Bandyyopadhyay, U. and Banerjee, R.K. (2004). Turmeric and cur cumin: Biological actions and medicinal applications Curr. Sci. 87(1): 44-53.

DiMario, F.; Nouvenne, A.; Stefani, N.; Cavestro, G.M.; Lori, V.; Mnio, M.; Comparato, G., Fanigliulo, L.; Pioltto, E.; Martelli, L.; Martelli, M.; Lean dro, G. and Franze, A. (2007). A Curcumin-based 1 week triple therapy for eradication of Helicobacter pylori infection: something to learn from failure? Helicobacter, 12: 238-243.

Eckles, C.H.; Combs, W.B. and Macy, H. (1997). Milk and milk products. 4th ed. Tatamc Graw Hill Publishing Company. New Delhi.

Egan, H.; Kirk R.S.; Sawyer R. (1981). Pearson's Analysis of Foods, 8th edit. Churchill Livingstone, Edinburgh London Melbourne and New York, 536–538.

Egan, H.; Kirk, R.S. and Sawyer, R. (1985). Persons chemical analysis of food 8th Ed Churchil living stone London.

El-Diam, N.M.S.A. and El-Zubier, I.E.M. (2010). Chemical composition of processed cheese using Sudanese white cheese. Research Journal of Animal and Vet Sci., 5: 31-37.

El-Ghorab, A.H.; Nauman, M.; Anjum, F.M.; Hussin, S. and Nadeem, M. (2010). A comparative study on chemical composition and antioxidant activity of ginger (*Zingiber officinale*) and cumin (*Cuminum cyminum*). Journal of Agricultural and Food Chemistry 58: 8231–8237.

Foad, M.I.; El-Sheikh, M.M.; El-Kholy, W.I. and Seleet, F.L. (2006). Herbs as a way for improving quality and prolonging shelf-life of soft cheese. Annals. Agri. Sci., Ain Shams Univ., Cairo, 51(2): 457-467.

Frankel, E.; Huang, S. and Prior, E. (1996). Evaluation of antioxidant activity of rosemary extracts, carnosol, and carnisic acid in bulk vegetable oils, and fish oil and their emulsions. Journal of the Science and Food Agriculture 72: 201–208.

Hosny, I.M.; El-Kholy, W.I.; Murad, H.A. and El-Dairouty, R.K. (2011). Antimicrobial activity of Curcumin upon pathogenic microorganisms during manufacture and storage of a novel style cheese 'Karishcum". Journal of American Science, 7(5): 611-618.

Hossain, M.A. and Ishimine, Y. (2005). Growth, Yield and Quality of Turmeric (*Curcuma longa* L.) Cultivated on Dark-red Soil, Gray Soil and Red Soil in Okinawa, Japan. Plant Production Science, 8: 482-486.

Hussein, G.A.M. (2004). Manufactured of flavourd Tallaga cheese. Egyptian J. Dairy Sci., 32: 277-290.

ISO (2006). ISO standard, 4831:2006. Horizontal method for the detection and enumeration of Coliforms-MPN technique.

ISO, (2003). ISO standard DIS 4833:2003(E) .Microbiology of food and feeding stuff/ Horizontal method for the enumeration of microorganisms/ colony count technique at 30°C.

Joslyn, M.A. (1970). Methods in food analysis, physical, chemical and instrumental methods of food analysis. 2nd Academic press. New York.

Kamal, M.Z.U. and Yousuf, M.N. (2012). Effect of Organic Manures on Growth, Rhizome Yield and Quality Attributes of Turmeric (*Curcuma longa* L.). The Agriculturists, 10: 16-22.

Khalifa, S.A. and Wahdan, K.M. (2015). Improving the quality characteristics of white soft cheese using cranberry (*Vaccinium macrocarpon*) fruit extract. International Food Research Journal 22(6): 2203-2211.

Krishnakumar, I.; Kumar, D.; Ninan, E.; Kuttan, R. and Maliakel, B. (2015). Enhanced absorption and pharmacokinetics of fresh turmeric (*Curcuma longa* L) derived curcuminoids in comparison with the standard curcumin from dried rhizomes. Journal of Functional Foods, 17: 55-65.

Langner, E.; Greifenberg, S.; Gruenwald, O. (1998). Ginger: history and use. Adv. Ther: 15: 25–44.

Ling, E.R. (1956). A text book of dairy chemistry Vol. 2 chem. And Hall Ltd.

Menon,V.P. and Sudheer, A.R. (2007). Antioxidant and antinflammatory properties of Curcumin. Adv. Eep. Med. Biol. 595: 105-125.

Murad, H.A. (1998). Antimicrobial activity of some natural extracts and its potentiality for controlling yeast growth in Yoghurt. J. Agric. Sci. Mansoura Univ.23 (12):6115-6125.

SAS, Statistical Analysis System. SAS User's. 2004, Statistics SAS Institute Inc. Editors, Cary. NC.

Talib, A.M.; Abubakar, M.M. and Jideani, I.A. (2006). Effect of different concentrations of jiben (*Solanum dubium*) seed extracts on the physicochemical and organoleptic properties of soft cheese. J. Agric. Sci. Mansoura, 31: 6951–6953.

Talib, A.M.; Abubakar, M.M.; Jideani, I.A. and Hassan, A. (2009). Use of Jiben seeds extract to manufacture soft white cheese. Am. J. Appl. Sci., 6: 551–554.