USING DIFFERENT LEVEL OF INULIN AS A CREAM REPLACER TO PRODUCED COTTAGE CHEESE

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ABSTRACT

Different concentrations of Inulin was added to observed the effecting on the chemical and sensory characterizes of cottage cheese product, (1, 2 and 3) % of Inulin were used as additive material to cottage cheese curd contain 0.1 percent of the milk fat, the experimental Cottage cheese samples were compared with the control sample of Cottage cheese contain 4% of milk fat. The milk fat content was standardized to 4% fat in control sample by adding cream 40% milk fat. After short period of storage (1,7 and 15)days, the chemical composition and each of Acetaldehyde ,volatile fatty acids, consistency, pH, and titratable acidity were determined and tested in the produced cheese, the sensory properties was evaluated in same period of storage, 2% and 3% of inulin caused negatively affecting on the volatile fatty acids contain while caused positive affecting on the consistency that increased with increased of the percentage addition of inulin, in this research the addition of the inulin had an observed effect on the acidity, pH, and Acetaldehyde whereas of 1% inulin was had a same effect of chemical and sensory characteristics of cottage cheese which was produced by adding 4% of butter fat (control cheese treatment), cottage cheese sample 3% inulin recorded low score of sensory evaluation compared with 1% inulin which had high score of sensory evaluation.

Keywords: cream replacers, Inulin, Low-fat cottage cheese, Storage.

1-INTRODUCTION

The major heart and cardiovascular and other disease such as hypertension and atherosclerosis affected by diet, in addition more, the obesity affected by diet [1]. Nutritionists recommended to consumption low amount of animal fat [2], or dairy fat to reduction many health problems or helping to solved it must not consumption or consumed a little amount of animal fat [3].

2. LITERATURE REVIEW

Inulin

In the last years the nutritionists give a big role of some food such as inulin which found in not less than 36000 species of plant as garlic, wheat, chicory, bananas, onion, and asparagus, inulin is a natural plant used to regulating resistance of cold and provide energy [4,5]. German scientist Valentin Rose was the first one who is discovered the inulin in 1804 [6]. Inulin helps Lactobacilli and Bifidobacteria growth which are important for human health, and has effect to inhibition of pathogenic bacteria, Tako in 2001 found that fortified of the food as a dairy products by addition of inulin maybe decreased the heart disease problems[7], consumption food contain a good source of fiber as inulin protect from many disease as colon cancer, inulin widely used and has active application in dairy replacer science as fat [8,9],

prebiotics[10,11,12,13,14], texture modifier [9,11].

Cottage cheese

Cottage cheese is one of the common soft cheese has a special taste and flavor. The cheese is a soft because some of the whey is not drained and remain with the curd. The acidity of the curd usually is removed by washing, to give sweet taste for the curd, we can distinguished two type of the curd during processing small curd and large curd, cottage cheese is not ripened and not colored [15], cottage cheese was named in 1831 in a first time[16] because in the old years the cheese was made in cottage from cow , ovine or other type of milk left after making butter [17] that is why cottage cheese is a low calorie cheese with minimal fraction of fat, while produced creamed cottage cheese, the curd is mixed with a low fat cream containing different ingredients for specific flavour or nutritive value [18,19], Researchers have demonstrated that high quality cottage cheese can be made only from not fat dairy milk that meets rigid specifications[20,21].

2. MATERIALS AND METHODES

Materials: the cow milk prepared from pakrajow dairy cows farms (Suleimani University, College of Agriculture Science). Inulin (Aurica-Germany). Lyophilized starter cultures containing *Streptococcus lactis sub sp. cremoris* and *Streptococcus lactis ssp. Biovar diacetylactis* (Marshall, France co.) used to produce of cheese.

Chemical analysis of milk: The milk samples were analyzed by milkoscan (model Foss, Infra-red milk analyzer, Swede) for protein%, fat%, lactose%, total solids T.S%, solids not fat SNF%, titratable acidity, density kg/l.

Making of Cottage cheese: skim milk 0.1% fat was using to produce of cottage cheese treatments, the curd cheese were divided into three treatments, while the control cheese contained 4% of milk fat [22]. Different concentration of inulin was added to the curd of cottage cheese treatments as clear in the table 1. The milk separator (Electrem, France) was used to obtain cream 40% fat which used to manufacture of control cheese, while skim milk was used to make of cottage cheese. Curd of cottage cheese inoculated with 2% of Streptococcus lactis sub sp. cremoris and Streptococcus lactis ssp. Biovar diacetylactis (w/v). After blending the curd of cottage cheese with inulin in varying ratios, putting into plastic containers, ca. 200g, all the cheese treatments were stored at 4 C° for two weeks then were sampled after 1, 7 and 15 days of storage.

Sample	Inulin%	milk fat %
A (Control)	4	0
В	0.1	1
С	0.1	2
D	0.1	3

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Analysis: total solid, protein, ash were analyzed according to AOAC[23] ,lactose contents, acetaldehyde, fat and titratable acidity were analyzed according to AOAC[24] ,the digital pH meter (Pye unican co.) was used to measuring pH values of the cottage cheese during the periods of storage, HPLC(shimadzu)

3. RESULTS AND DISCUSSION

Milk composition: the chemical compositions of skim milk which used for manufacturing of

was used to determination of volatile fatty acids according to[25], according to the 0-5 points scale all the sensory characteristics(colors and appearance, texture, taste and aroma and general acceptability) were evaluated by lecturer dairists in the dairy technology laboratory then the data research was analyzed by using anova program.

cottage cheese were analyzed for selected parameters as clear in table 2.

The composition	The percentage (%)
Protein	4.29%
Lactose	4.98%
Fat	0.1%
T.S	10.01%
SNF	9.98%
Titration Acidity(as lactic	0.18%
acid)	1.035 kg/l
Density	

Table (2): Chemical composition of skim milk used for cheese production

The chemical composition of cottage cheese samples is shown in table 3, the rang of protein was between 18.83% and 20.31% while the total solid content ranged between 23.14% and

26.27%, total protein, lactose and ash increased in samples B,C, and D as illustrated in the figure 1.

Table(3):Chemical composition of experimental cottage cheese sample

samples	Total solids%	Fat%	Protein%	Lactose%	Ash%
A(Control	26.27±0.32	4.20±0.01	18.83±21	2.52±0.02	0.718±0.02
)	23.14±0.91	0.1±0.01	19.10±12	2.72±0.03	1.22±0.01
В	24.23±0.56	0.1±0.01	19.87±23	2.88±0.01	1.38±0.01
C	24.77±0.42	0.1±0.01	20.31±41	2.91±0.09	1.45±0.03
D					

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The data of chemical and physical properties of cottage cheese during storage are shown in table (4), the pH value were between 4.94 and 5.01 on the first day, and between 4.71 and 4.79 after15 day, generally the pH values were

gradually decreased during storage, in all of the treatments of inulin as a fat replacer did not significantly affect the pH values (P<0.05), that illustrated in figure 2.



Figure (2): effect of inulin on the pH of the cheese during storage

That is not affecting was observed in the acidity of curd cheese samples by different ratio of inulin and increases were found during storage (P<0.05). but a little differences were found after two weeks, that was in cheese B treatment contain 1% of inulin which had the highest acidity ,increased to become 0.79% after 15 days storage whilst was 0.68% in the first day. The acidity of the cottage cheese was developed with the length of storage periods and that gave statistically significant(p>0.01), as

well as the pH values was decreased, the starter used to produced that cottage cheese Streptococcus lactis sub sp. cremoris and Streptococcus lactis ssp. Biovar diacetylactis maybe effects on the pH and caused decreased it and in the same time increased of the acidity, observed similar result were bv other researches[8], [26] reported that inulin did not negatively change the activity of starters, [10] observed positively effect of inulin on the development acidity in some dairy products.



Figure(3): Effect of inulin on the titratable acidity of the cheese during storage

About the effect of different concentration of inulin on the consistency, we can observed a large effect on the cheese treatments by increased of inulin concentration at first day The effects of different levels of inulin were statistically significant on the curd consistency over all storage time (P>0.01) as illustrated in figure 4. While table 4 clears that sample B had the lowest consistency values during storage, it was 296.11mm after 15 day. The consistency of control cheese (A) was higher than cheese B, but consistency was highest in cheese C containing 2% inulin(332.37mm) as shown in table(4), the high level of consistency of cheese C was due to its inulin content, consistency of cheese decreased during storage, but this was not found to be statistically significant (P<0.05). According on the results the consistency was a strong at first day in C and D treatment and become less strong

during the storage with increase of inulin level, Each of [16, 27] reported cottage cheese its unique among the others cheeses, it is not pressed, and it has a more amount of whey that is why this cheese has a weak consistency. Curd important to give good physical properties, inulin analysis by starter activity caused decreasing of the cheese consistency.consistency in cheese is very The acetaldehyde content was a highest in the control sample of cottage cheese after one day (8.98mg/kg) and after one and two weeks become (7.86, 7.08) mg/kg respectively after with B sample which had storage compared lowest value of acetaldehyde after 1,7and15 day of storage (7.48, 7.70, 6.18) mg/kg respectively as illustrated in the figure 5 .also D treatment had a high content of acetaldehyde compared with control treatment, significant different (p>0.05) were found among treatments.



Figure (4): Effect of inulin on the Consistency of the cheese during storage



Figure (5): Effect of inulin on the acetaldehyde of the cheese during storage

addition of inulin to the curd of cottage cheese positively was affecting on the volatile fatty acids content, the highest of volatile fatty acids was found in C sample after two weeks of storage (4.94) ml, while the lowest value was found in the B sample after two weeks of storage (4.26) ml, in generally the value of volatile fatty acids was increase during storage with increase of inulin concentration and this increase caused statically significant (P>0.01), that clear in figure 6. So were observed that acetaldehyde decreased with increased of inulin levels in extent storage periods and this which caused decreased in taste score of sensory properties if we remember that content of

volatile compound helps to development each of taste and aroma, that contributes to development of cheese flavor [28]; [29] reported that cheese flavor and taste are formed by volatile components by adding starter or by milk constituents, through different periods of storage the acetaldehyde content were decreased and that cause significant difference (p>0.05). the alcohol dehydrogenase activity that is why the acetaldehyde content was low or decreasing after the storage , as many of starter that use to give a taste and flavor the *Streptococcus lactis sub sp. cremoris* and *Streptococcus lactis ssp. Biovar diacetylactis* contribute to developed them, as certified by other researchers [30].

parameter	samples	Storage(day)			
		1	7	15	
pH	А	5.01±0.04 ^a	4.86±0.03 ^a	4.72±0.04 ^a	
	В	$5.00{\pm}0.02^{a}$	4.87 ± 0.02^{a}	4.79 ± 0.03^{a}	
	С	$4.94{\pm}0.03^{a}$	$4.84{\pm}0.04^{a}$	4.71 ± 0.12^{a}	
	D	4.98 ± 0.01^{a}	4.86 ± 0.09^{a}	$4.74{\pm}0.18^{a}$	
Titratable acidity%	А	0.62 ± 0.03^{a}	0.69 ± 0.07^{a}	0.75 ± 0.09^{a}	
	В	$0.68{\pm}0.04^{a}$	0.71 ± 0.02^{a}	$0.79{\pm}0.08^{a}$	
	С	$0.63{\pm}0.05^{a}$	$0.67{\pm}0.05^{a}$	$0.71{\pm}0.09^{a}$	
	D	0.63 ± 0.06^{a}	0.66 ± 0.05^{a}	0.71 ± 0.03^{a}	
Consistency mm	А	316.5 ± 6.25^{bc}	308.70±24.71	303.48 ± 3.75^{b}	
-	В	305.79±20.11 ^c	cb	296.11±7.5 ^b	
	С	332.37±14.09 ^a	$301.94 \pm 8.59^{\circ}$	326.47 ± 9.4^{a}	
	D	329.05±10.71 ^{ab}	323.00±4.17 ^a	317.79±11.36 ^a	
			320.02 ± 3.00^{a}	b	
			b		
Acetaldehyde mg/kg	А	$8.98{\pm}0.07^{a}$	7.86 ± 0.04^{a}	7.08 ± 0.14^{a}	
	В	7.48 ± 0.03^{a}	7.70 ± 0.04^{a}	6.18 ± 0.14^{a}	
	С	$8.32{\pm}0.04^{a}$	8.00 ± 0^{a}	$6.90{\pm}0.07^{a}$	
	D	$8.14{\pm}0.14^{a}$	7.00 ± 0.21^{a}	7.02 ± 003^{a}	
Volatile Fatty Acids	А	3.66 ± 0.30^{b}	4.06 ± 0.30^{a}	4.36 ± 0.02^{a}	
ml/100g	В	3.86 ± 0.03^{a}	4.05 ± 0.02^{a}	4.26 ± 0.02^{a}	
	C	$4.34\pm0.02^{\circ}$	4.44 ± 0.02^{b}	4.94 ± 0.02^{b}	
	D	4.24 ± 0.02^{d}	4.25±0.01 ^b	4.74±0.03 ^b	

Table (4): Chemical and Physical characteristics of Cottage cheese during storage

The significant differences in the same column (p < 0.05)



Figure (6): Effect of inulin on the volatile fatty acid of the cheese during storage

All of the sensory properties were high in the control treatment during the storage periods,

each of the color and appearance, texture, taste and aroma, and general acceptability were (4.0, 3.61, 8.32 and 4.14) score respectively after the fifteenth days of storage and were the highest compared with the other treatments except the texture properties which was lower than B treatment 1% inulin which was 3.81 score, but the results of the evaluation of this treatment was nearly from the control treatment, it had (3.90, 3.81, 7.44 and 3.61)score respectively after 15 day of storage, while the results of the sensory evaluation of the C treatment was same of the result of evaluation D treatment during the storage periods and each of them was lower than control treatment, so found significant

difference (p>0.01) between the treatments as show in the table 5 and figure 7. Over all, inulin reduced the taste and aroma during storage compared with the first day when the cheese had a high score of taste and aroma [19, 31]. About sensory properties, B sample had a high scores of the taste because it contain a low of inulin level 1% compared with the control sample A, we can say 1% is a good percentage of inulin to addition as a prebiotic whereas the C and D sample which contain a high level of inulin 2% and 3% respectively that negatively effect on all of the sensory properties of the cheese.

Table (5):	Sensory Pro	perties of Cot	tage Cheese d	uring storage
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parameter	sample	Storage(day)		
		1	7	15
Color and Appearance(0-5 score)	А	4.73 ± 0.80^{a}	4.01 ± 0.80^{ab}	4.00 ± 0.85^{a}
	В	4.61 ± 0.74^{b}	3.77 ± 1.05^{b}	3.90 ± 0.81^{a}
	С	4.19 ± 0.65^{ab}	4.35 ± 0.75^{a}	3.98±0.90
	D	$4.42\pm0.72^{\circ}$	$4.80{\pm}0.80^{ab}$	3.60 ± 0.80^{a}
Texture(0-5 score)	А	4.49 ± 0.55^{a}	3.91 ± 0.90^{a}	3.61 ± 0.80^{a}
	В	4.50 ± 0.82^{a}	3.80 ± 0.91^{a}	3.81 ± 0.95^{a}
	С	4.44 ± 0.95^{a}	4.07 ± 0.95^{a}	3.40 ± 1.00^{a}
	D	4.37 ± 0.55^{a}	3.33 ± 0.80^{a}	3.55 ± 0.90^{a}
Taste and Aroma(0-10 score)	А	$8.70{\pm}2.85^{a}$	7.91 ± 2.70^{a}	8.32 ± 2.49^{a}
	В	8.58 ± 1.19^{a}	7.62 ± 1.37^{a}	7.44 ± 1.33^{b}
	С	7.55 ± 1.59^{b}	7.49 ± 1.161^{a}	$6.64 \pm 1.66^{\circ}$
	D	$7.40{\pm}0.99^{b}$	$7.70{\pm}2.01^{a}$	5.32 ± 1.44^{c}
General acceptability(0-5 score)	А	4.63 ± 0.40^{a}	3.80 ± 0.99^{a}	4.14 ± 0.66^{a}
	В	4.44 ± 0.66^{ab}	3.81 ± 0.68^{a}	3.61 ± 0.91^{ab}
	С	4.22 ± 0.90^{b}	3.82 ± 0.77^{a}	3.33 ± 0.93^{bc}
	D	4.39 ± 0.50^{ab}	3.27 ± 1.00^{b}	3.32 ± 0.77^{c}



Figure (7): Sensory Properties of Cottage Cheese during storage

4. CONCLUUIONS

Using a low concentration of the inulin 1% gave a positive result of the cottage cheese samples during storage periods(1,7 and 15)day especially had a good effect of consistency, texture properties, and it had a same result of control

5.REFERENCES

- Godfrey S.Getz Catherine A.Readon, (2007) Nutrition and Cardiovascular Disease. https://doi.org/10.1161/ATVBAHA.107.1 55853,Arteriosclerosis, Thrombosis, and Vascular Biology. 2007; 27:2499-2506, originally published November 20, 2007.
- [2] Tian yi, Xinjan Huang, Siyi Pan and Lufeng Wang2014, Liyofilize edilmis proteinkaynakli yag ikame maddelerinin Edam peynirinin teksturve olgunlasmasina etkisi *International Journal of Food Science and Nutrition*, Vol 65, No, pages 565-572.
- [3] Haque Z U and Ji T, 2003, International Journal of Food Science and Technology.

treatment 4% milk fat. While using high concentration of inulin 2% and 3% do not give a good result and it had negative effect on the physical properties in cottage cheese, so using low concentration 1% is recommended to produce a low fat healthy cheese.

Cheddar whey processing and source: II. Effect on non-fat ice cream and yogurt. Vol 38, pages 463–473.

- [4] Niness^{a b}, KR. 1999"Inulin and oligofructose: what are they?". *The Journal of nutrition* 129 (7 Suppl):, 1402S–6S. PMID 10395607.
- [5] Kalyani^{a b c d} Nair, K.; Kharb, Suman; Thompkinson, D. K.. 2010"Inulin Dietary Fiber with Functional and Health Attributes—A Review". *Food Reviews International* (18 March)26 (2): 189– 203. Doi: 10.1080/87559121003590664.
- [6] Boeckner, ^{a b c} LS; Schnepf, MI; Tungland, BC. (2001) "Inulin: a review of nutritional and health implications." *Advances in*

food and nutrition research 43: 1– 63.Doi:10.1016/s1043-4526(01)43002-6. PMID 11285681.

- [7] Tako, E.; R. P. Glahna, R. M. Welcha, X. Leia, K. Yasudaa and D. D. Miller 2008.
 "Dietary inulin affects the expression of intestinal enterocyte iron transporters, receptors and storage protein and alters the microbiota in the pig intestine". *Br. J. Nutr* 99: 472–480. doi: 10.1017/s0007114507825128.
- [8] Mguven, Kyasar, Obkaraca, and A Ahayaloglu. (2005) The effect of inulin as a fat replacer on the quality of set-type low-fat yogurt manufacture. *Society of Dairy Technology*, Vol 58, No3,, Pages 180-184.
- [9] Tati Pimentel, Suellen Jensen klososki, Mickele Rosset, Gislaine Silveiva Simoes. 2007Inulin as a fat replacer in Dairy Products, Chemical properties, uses and health benefits, edition 1th, chapter 3,Nova Science Publisher, editors: Cristian R Davis, pp. 109-152.
- [10] Khaleel and A.A.Thaer. (2017) Using probiotics and Inulin to Prolong Fermented Dairy products Shelef Life. *The Iraqi Journal of Agricultural Siences*, 608-617: (2) 48/2007.
- [11] Bayarri S., Isabel Harnando, ElviraCostell, Luis Gonzalen-Tomas. Texture perceived on inulin enriched low fat semisolid dairy desserts rheological and structural basis, *Journal of Texture Studies*, 2011 (42):3 147-184.
- [12] Tatiana Cpimente, Sandra Garcia and Sandra H Proudencio. 2012Effect of Long Chain Inulin on the texture profile and Survival of Lactobacillus Paracasei spp Paracasei in set yogurt during refrigerated storage. *International Journal of Dairy Technology*, vol 65, No1.

- [13] Sirimu Celestin, S.S Thorat, R. J Desale, U D Chavan. 2015 Effect of Milk Supplementation with Fructooligosaccharides and inulin on Viable Count of probiotic Bacteria in Goat and Cow Milk Yoghurts. Journal ofEnvironmental Science, Toxicology and Food Technology, vol 9 ver 1 pp 06-12.
- [14] Erika Flimelova, Vladimira Knazovicka, Margita Canigova, Emilia Benczova 2013.Changes in Quality of Fresh Cheese Using Dressing with and without Probiotic Culture durin storage,ACTA Universitatis Agriculturae ET Silviculturae Mendelanae Brunensis, vol LXI No 1.
- [15] Codex Alimetarius Volume XVI (1984).
 International individual standard for Cottage Creamed cheese, standard NO.C-16(1968); FAO, WHO, Rome.
- [16] Eva Buchi. Etymological dictionaries2008. Philip Durkin. The Oxford Handbook of Lexicography, Oxford University Press, pp.338-349, 2016, 978-0-19-969163-0.
- [17] Driscoll, Michael; Meredith Hamiltion, Marie Coons2003. A Child's Introduction Poetry. 151 West 19th Street New York, NY 10011: Black Dog & Leventhal Publishers., p. 10. ISBN 1-57912-282-5.
- [18] Tratnik, Lj. G. Miokovi, Mljekarstvo, 4 .1995 107-117.
- [19] Kosikowski FV1978. Cheese and Fermented Milk Foods, 2nd edn, P 711, New York: Brooktodale.
- [20] Dowty, B., D.Carlisle, J. L.Laseter, and J.Storer1975. Halogenated hydrocarbons in New Orlleans drinking water and blood plasma. Science, 187:75-77.
- [21] Hekmti, M., and R. L. Bradley, Jr1979. Effect of milk constituents on the

persistence of sodium hypochlrite. 1. Dairy Sci., 62:47-48.

- [22] Kosikowski, V.V.Mistry1997. Cheese and Fermented Milk Foods, Vol. 1, F. V. Kosikowski (Ed.), Westport, Connecticut.
- [23] AOAC. (1990), Official methods of analysis of the AOAC, 15th ed. Methods 932.06, 925.09, 985.29, 923.03. Association of official analytical chemists. Arlington, VA, USA.
- [24] AOAC, (2000). Association of Official Analytical Chemists. Official Methods of Analysis. 17th ed. Gaithersburg, Maryland, USA, AOAC International.
- [25] Korin 20(1982),. Food Analysis Methods complied by Japan Food Industry Society food analysis methods, Editing committee Repuplished by KORIN 20.
- [26] Recardo Pinheiro de Sousa Oliveira^{a, b},
 Patrizia Perego^b, Marice Nogueria Oliveira^a
 de, Attilio Converti^b. 2011. Effect of inulin
 as prebiotic and synbiotic interactions

between probiotics to improve fermented milk firmness .Journal of Food Engineering, 107, Pages 36-40.

- [27] National Dairy Council (2000). Newer Knowledge of Dairy Foods/ Cheese. Dairy Management, Incorporation Rosemont, IL, 2001, USA 60018-5616
- [28] Niimi, J., Eddy, A. I., Overington, A. R., Silcock, P., Bremer, P. J., & Delahunty, C. M (2015), .Sensory interactions between cheese aroma and taste. *Journal of Sensory Studies*, 30, 247–57.
- [29] Urbach G1997. The flavor of milk and dairy products: II. Contribution of Volitale compounds Int. J. Dairy Techno:, 50, 79-89.
- [30] Lees GJ and Jago GR1969. Methods for the estimation of acetaldehyde in cultured dairy products. Australian *Journal of Dairy Technology*, , 24 181-183.
- [31] Farkye N Y (2004). Cheese Technology, *International Journal of Dairy Technology*, and vol 57 issue 2-3 pp 91