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UTILIZATION OF TURMERIC AS A NATURAL PIGMENT IN RAS CHEESE

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ABSTRACT

The research on curcumin has received a considerable attention due to its pronounced medical and industrial properties. Turmeric as a natural pigment with its active component curcumin was used in this study in the manufacture of Ras cheese as a replacer to annatto. Ras cheese was manufactured in triplicate with replacement of annatto by addition of 0%, 0.5, 1%, 1.5%, 2% and 2.5% turmeric. Cheeses were ripened at 12±2°C for 3months. Chemical analysis for moisture, fat, salt in moisture, pH, acidity, total nitrogen content (TN), water soluble nitrogen (WSN) and total volatile fatty acids (TVFA) were determined as well as bacteriological analysis to the treatments. Sensory evaluation of Ras cheese was performed when fresh and during ripening every month .The cheeses were graded for characteristics "Flavor/aroma, body/texture and appearance". The percentage of moisture decreased and the salt % increased in all matured Ras cheese especially in the samples ripened for 90 days. The fat content %, the mean values for TN%, WSN/TN% and TVFA increased along with the increase in turmeric concentrations in all of the treatments. Sensory evaluation of the Ras cheese samples manufactured with 0.5 % and 1% turmeric exhibited more acceptable sensory evaluations than the cheese samples made with higher turmeric concentrations compared with the control cheese manufactured with annatto.

To conclude, turmeric could be used as a natural pigment in the dairy products that may help focus on its beneficial medical and industrial properties.
Keywords: Tumeric– Ras cheese - Chemical composition – Sensory properties

INTRODUCTION

In the recent years, the concept of providing functional foods containing healthy components rather than removing potentially harmful ones is gaining ground in the world. Functional foods, designer foods, pharmafoods and nutraceutricals are synonyms for foods with ingredients that can prevent and treat diseases (Scheinbach, 1998). Curcumin is a natural compound found in the plant *Curcuma longa* which is used as a food additive known as turmeric. The major pigment in turmeric is curcumin (chemical name diferuloymethane) (Ammon and Wahl, 1991). Curcumin, after oral dosing, is rapidly metabolized in the intestine to several reduced products (di-, tetra-,hexahydrocurcumin, and hexahydrocurcuminol) and their glucuronide or sulfate conjugates (Wang *et al*., 2008). Natural pigment is a vital quality attribute of foods, and plays an important role in sensory and consumer acceptance of products (Giusti and Wrolstad, 1996). Curcumin is an important permitted natural colorant used in food, nutritious and pharmaceutical preparations among others (Sowbhagya *et al*., 1998).

Surh (2003) stated that curcumin has been found to prevent, reverse, or delay the carcinogenic process acting as a dietary chemo preventive agent. The research on curcumin has received a considerable attention due to its pronounced anti-inflammatory (Satoskar *et al*., 1986), immunomodulating, anti-atherogenic and anti-oxidative properties (Toda *et al*., 1985 and Surh., 2002), and it may help in Alzheimer's disease (Larry and Alex, 2004). Topical application of curcumin inhibits the development of skin tumors. Curcumin also strongly inhibits proliferation of some human colon cancer cell lines (Hanif *et al*., 1997). Curcumin also reduces colonic inflammatory responses (Plummer *et al*., 1999) and inflammatory bowel disease (Peter et *al*., 2005). Miquel *et al*., 2002 and Banerjee *et al.,* 2003 stated that curcumin showed the strong antioxidant and anti-cancer properties through regulating the expression of genes that are critically related to the oxidant stress. These curcumin-induced alterations include reverse insulin resistance, hyperglycemia, hyperlipidemia, and other symptoms linked to obesity (Aggarwal, 2010). Today, it is also used as spice, in curry and as a food dye (E100) and preservative as well (Aggarwal *et al*., 2005). Human clinical trials indicated no dose-limiting toxicity when administered at doses up to 10 g/day. Pharmacologically, curcumin has been found to be safe. (Aggarwal *et al*., 2003)

This study aimed to the manufacture of Ras cheese with turmeric as a natural pigment with replacing annatto by 0%, 0.5%, 1%, 1.5%, 2% and 2.5% of turmeric as a natural pigment so that it may help to focus on the industrial applications of turmeric.

MATERIALS AND METHODS

1-Materials

Fresh cow's milk used in this study was obtained from the herd of Animal production Research Institute, Ministry of Agriculture (Sakha Experimental station).

Streptococcus thermophilus and *Lactobacillus delbreuckii* ssp. *bulgaricus* mixed culture was obtained from Chr. Hansen's Lab., Denmark.

Standard animal rennet powder was obtained from Chr. Hansen's Lab., Denmark. Commercial edible grade sodium chloride was obtained from El-Nasr Company for salt, Alexandria, Egypt. Tumrmeric concentrate was obtained from Warner Jenkinson (St. Louis, MO).

2-Methods

Ras Cheese Manufacture

Ras cheeses were manufactured in triplicate as described by Hofi *et al*.,(1973) with replacement of annatto by addition of 0%, 0.5%, 1%, 1.5%, 2% and 2.5% turmeric as a natural pigment in the same way as usually used with annatto. Cheeses were ripened at 12±2°C for 3months.

Chemical analysis

Samples of Ras cheeses were analyzed in duplicate for moisture, fat, salt in moisture, pH, acidity, total nitrogen content (TN) and water soluble nitrogen (WSN) according to Ling (1963). Total volatile fatty acids (TVFA)

were determined by the distillation method described by Kosikowski (1966), values were expressed as ml (0.1 N) NaOH/100gm cheese.

Microbiological analysis

Ras cheeses were aseptically sampled in duplicate when fresh and after 2weeks, 1, 2 and 3 monthly intervals during the ripening period for microbiological analysis. Samples were emulsified in sterile 2% (w/v) trisodium citrate, diluted in maximum recovery diluents (oxoid), and appropriate dilutions were pour-plated.

Lactic acid bacteria was enumerated according to Elliker *et al.* (1956). Coliforms were enumerated according to Harrigan and McCance (1996) using Violt Red Bile agar media. Moulds & yeasts, *Listeria monocytogenes, Staphylococcus aures* and *Sallmonella* sp., lipolytic bacteria and caseolytic bacteria were determined according to American public health Association methods (APHA, 1994). Total bacterial counts were enumerated on standard plate count agar (Marth, 1978).

Sensory evaluation of Ras cheese

Cheeses were graded blindly when fresh and during ripening every month by panel members of Dairy Science Department, Food Technology Research Institute and Dairy Science Department, Faculty of Agriculture-El-Fayoum University. The cheeses were graded for characteristics "Flavor/aroma, body/texture and appearance" with maximum scores of 50, 35 and 15, respectively and for total rating of 100.

RESULTS AND DISCUSSION

Chemical composition of Ras cheese

Table (1) and Figure (1) revealed that the percentage of moisture decreased and the salt % increased in all matured Ras cheese groups and especially in the samples ripened for 90 days. These results are in agreement with those reported by Badawi (1998), Hussein *et al*., (2006). The fat content % in all of the 3 replicates increased by increasing the turmeric concentration and became highest in the samples with 2 and 2.5% turmeric, this could be explained as tumeric contains 5-10% Fat (CSIR, 1950) and ripened for 90 days where the moisture % decreases on storage.

These results are similar with the results of Maia *et al*., (2004) who studied the Ricotta cheese supplemented with different concentrations of turmeric.

The titratable acidity gradually increased while pH values decreased in all cheese treatments during storage, this result coud be due to the decrease in moisture % and continuity of the starter culture activity. Similar trends were reported by Badawi (1998), Mehanna *et al*. (2002) and Fayed *et al*. (2006). This is in consistency with Foda and Awad (2007) who stated that turmeric decreased pH of fresh yoghurt but no significant reduction observed, while during cold storage, pH values decreased significantly.

Table 1. Chemical properties of Ras cheese as affected by turmeric concentration.

Parameters	Cheese age (days)	Treatment (turmeric concentration) %					
		0	0.5	1	1.5	2	2.5
Moisture (%)	Fresh	43.52	45.67	45.2	43.84	44.76	44.7
	15	39.35	43.47	42.65	42.81	42.04	43.04
	30	39.15	35.52	39.47	41.57	40.97	41.75
	60	36.74	34.55	39.17	32.36	38.48	39.7
	90	33.13	34.52	36.18	31.797	36.83	38.96
Salt%	Fresh	3.2	2.3	2.5	3	2.5	2.8
	15	6.5	3	5	4.5	5.2	3.5
	30	6.6	6.7	6.5	5.2	6	4.5
	60	7.2	7.5	6.7	8	6.8	6
	90	8.5	8.3	7.3	10.5	7	6.5
Fat%	Fresh	24	25	25	26	26.5	26.5
	15	25	25.5	27	26.5	27	29
	30	26.5	27	27	27	28.5	29
	60	27	29	27	29	29	29
	90	30	29.5	30	30	31.5	31.5
Titratable acidity%	Fresh	0.3	0.3	0.2	0.2	0.3	0.4
	15	0.4	0.4	0.4	0.5	0.4	0.4
	30	0.4	0.4	0.5	0.55	0.4	0.7
	60	0.5	0.5	0.6	0.8	0.6	0.7
	90	0.5	0.7	0.65	0.9	1.2	0.7
pH value	Fresh	7.39	6.9	7.28	7.25	7.11	6.97
	15	6.53	6.32	7.16	6.85	6.73	6.48
	30	6.5	5.93	6.22	5.89	6.14	5.9
	60	5.88	5.9	6.13	4.75	5.67	5.6
	90	5.73	5.1	5	4.18	4	5.2

Results are the average of 3 replicates

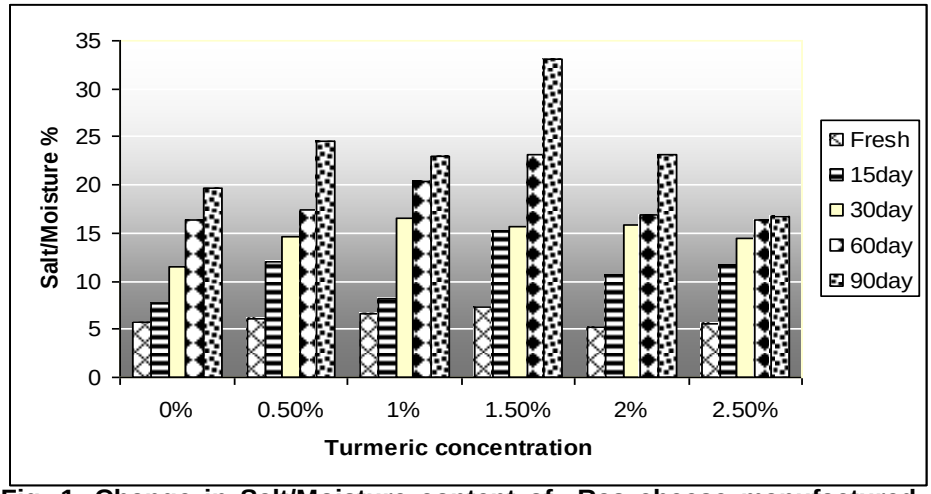

Fig. 1. Change in Salt/Moisture content of Ras cheese manufactured with different concentration of turmeric during ripening at 12°C

Ripening indices of Ras cheese

Table (2) demonstrates the increase in the mean values for TVFA along with the increase in turmeric concentrations in all of the treatments.

This result can be explained by the fact that total volatile oil accounts for 3-7% of the turmeric composition (CSIR, 1950). As Shown in Figure (2), the highest value for WSN/TN % was detected in the cheese treatment with 2.5% turmeric concentration and had been ripened for 90 days.

Table 2. Effect of turmeric content of Ras cheese on some ripening indices during ripening.

Ripening indices	Cheese age (days)	Treatment (turmeric concentration) %					
		0	0.5	1	1.5	2	2.5
TN(%)	Fresh	3.02	2.94	2.95	2.93	2.86	2.36
	15	3.13	3.09	2.96	3.01	2.97	2.47
	30	3.17	3.13	3.04	3.09	2.97	2.88
	60	3.19	3.21	3.1	3.33	3.04	2.95
	90	3.37	3.24	3.33	3.72	3.08	3
WSN/TN%	Fresh	0.162	0.157	0.163	0.109	0.202	0.101
	15	0.196	0.314	0.367	0.164	0.236	0.107
	30	0.405	0.639	0.607	0.325	0.336	0.209
	60	0.686	0.758	0.787	0.738	0.83	0.386
	90	0.935	0.894	0.893	0.757	0.943	0.951
TVFA*	Fresh	10	10	15	20	20	20
	15	20	20	20	20	20	30
	30	20	20	30	30	40	40
	60	40	30	40	40	40	50
	90	60	40	40	60	70	80

Results are the average of 3replicates
***Expressed as ml (0.1N) NaOH/100gm cheese.**

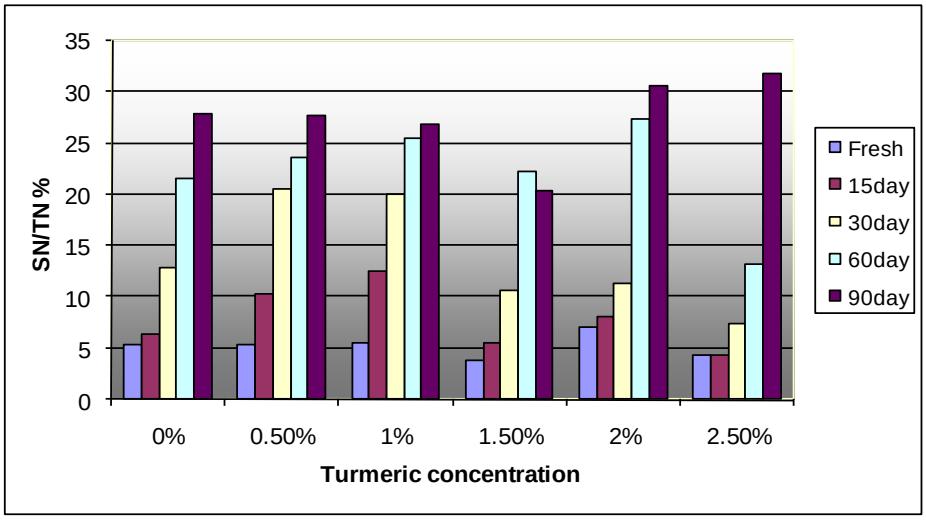

Fig. 2. Changes in SN/TN of Ras cheese manufactured with different concentration of turmeric during ripening at 12°C.

There was no significant difference between the mean values of TN% and WSN/TN% as compared with the control sample. This is in consistency with the results of Foda and Awad (2007) who detected increased values of

WSN/TN% in their yoghurt samples along with the increase in turmeric concentrations as compared with the control treatments with no turmeric or with the yoghurt samples with low turmeric concentration samples. Also WSN, WSN/TN and TVFA of all cheese treatments increased throughout the ripening period. These results are in agreement with those reported by Badawi (1998), Mehanna *et al.* (2002), Fayed *et al*. (2006) and Chen *et al*. (2009).

Organoleptic evaluation of Ras cheese:

Table (3) and Figure (3) demonstrates that sensory evaluation of the Ras cheese samples manufactured with 0.5 % and 1% turmeric exhibited a more acceptable properties than the cheese samples with 1.5%, 2% and 2.5% turmeric concentrations compared with the control cheese manufactured with annatto. Generally, all of the cheese samples manufactured with different concentrations of turmeric attained fewer score for sensory evaluation than the control. This is in consistency with Dorai *et al*. (2000) who stated that turmeric adversely affected sensory acceptability, and with Foda and Awad (2007) who described that mean score for appearance, body, texture and flavor decreased with increasing turmeric concentrations. However, turmeric had been frequently used as a natural colorant in yoghurt with yellow fruits (Prokupkova and Novotna, 1997). In the present study, all the treatments of Ras cheese attained highest evaluation scores for body, texture and flavor after ripening for 90 days. This is consistent with Mehanna *et al*. (2002) who stated that flavor score for all treatments of Ras cheese increased with age and peaked at 3 and 4 months. They added that body and texture improved with age being maximally at 4 months and appearance after 3 months of ripening.

Table 3. Sensory evaluation of Ras cheese manufactured with turmeric compared with Ras cheese manufactured with annatto

Ripening Period (days)	Cheese Properties	Turmeric %					
		0	0.5	1	1.5	2	2.5
30	Appearance (15)	11	11	11	10	10	9
	Body& Texture (35)	30	24	24	22	22	22
	Flavor (50)	35	32	32	30	29	28
	Total (100)	76	67	67	61	61	59
60	Appearance (15)	12	11.5	11	10.5	10	9
	Body& Texture (35)	32	26	25	25	24	23
	Flavor (50)	38	34	33	32	32	29
	Total (100)	82	71.5	69	67.5	66	61
90	Appearance (15)	12	12	12.5	11	10.5	10
	Body& Texture (35)	33	28	30	25	23	23
	Flavor (50)	42	40	35	33.5	33	31
	Total (100)	87	80	71.5	69.5	66.5	64

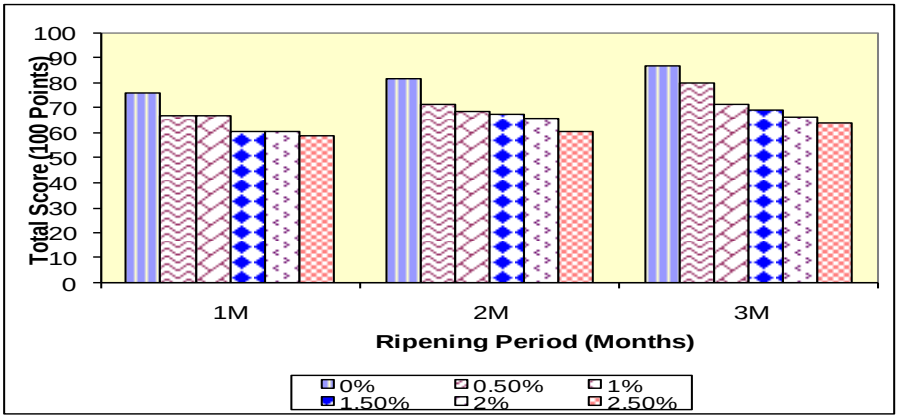

Fig.3. Changes in organoleptic properties of Ras cheese manufactured with different concentration of turmeric during ripening at 12°C.

Microbiological quality of Ras cheese

As shown in Table (4) counts of caseolytic bacteria, lipolytic bacteria, and yeast & mould in all cheese treatments increased during the ripening period. All samples were free of coliform bacteria, *Listeria monocytogenes*, *Staphylococcus aures* and *Sallmonella* sp., as a result of high hygienic conditions during the preparation and ripening period.

Table 4. Microbiological profile of Ras cheese manufactured with different concentrations of turmeric during ripening at 12°C.

Properties	Treatments*	Ripening Period (months)				
		Fresh	15day	30day	60day	90day
Total count (c.f.u./gm)	0%	$2x10^3$	$25x10^3$	$4x10^4$	$4x10^4$	$45x10^5$
	0.5%	$16x10^1$	$38x10^3$	$4x10^4$	$68x10^3$	$36x10^4$
	1.0%	$9x10^3$	$16x10^3$	$32x10^3$	$5x10^4$	$66x10^4$
	1.5%	$25x10^3$	$36x10^3$	$44x10^3$	$5x10^4$	$19x10^4$
	2.0%	$54x10^2$	$75x10^2$	$32x10^3$	$42x10^3$	$28x10^5$
	2.5%	$18x10^3$	$28x10^3$	$33x10^3$	$35x10^3$	$23x10^5$
Caseolytic bacteria	0%	N.D.	$25x10^1$	$4x10^2$	$27x10^2$	$29x10^3$
	0.5%	N.D.	$2x10^1$	$24x10^1$	$56x10^2$	$73x10^2$
	1.0%	N.D.	$5x10^1$	$12x10^2$	$39x10^2$	$5x10^3$
	1.5%	N.D.	$6x10^1$	$71x10^1$	$4x10^2$	$16x10^2$
	2.0%	N.D.	$31x10^1$	$15x10^2$	$31x10^2$	$5x10^3$
	2.5%	N.D.	$27x10^1$	$6x10^2$	$15x10^2$	$26x10^2$
Lipolytic bacteria	0%	N.D.	N.D.	N.D.	$11x10^1$	$75x10^1$
	0.5%	N.D.	N.D.	N.D.	$4x10^1$	$33x10^1$
	1.0%	N.D. N.D.	N.D. N.D.	N.D.	$2x10^1$	$41x10^1$
	1.5%	N.D.	N.D.	N.D.	$7x10^1$	$72x10^1$
	2.0%	N.D.	N.D.	N.D.	$51x10^1$	$52x10^1$
	2.5%			N.D.	$22x10^1$	$62x10^1$
Yeast & Mould	0%	N.D.	N.D.	$5x10^3$	$9x10^3$	$21x10^3$
	0.5%	N.D.	N.D.	$8x10^2$	$32x10^3$	$38x10^3$
	1.0%	N.D.	N.D.	$44x10^2$	$11x10^3$	$17x10^4$
	1.5%	N.D.	N.D.	$19x10^3$	$23x10^3$	$12x10^4$
	2.0%	N.D.	N.D.	$4x10^3$	$13x10^3$	$24x10^4$
	2.5%	N.D.	N.D.	$9x10^3$	$35x10^3$	$16x10^4$

N.D.: Not detected **cfu: Colony forming unit**

Conner (1993) reported that turmeric had little antimicrobial activity. Turmeric powder had no inhibitory effect on proteolytic and lipolytic organisms. Turmeric can not be used as the single preservative (Maia *et. al*., 2004). Moulds and yeasts were not detected until 1 month in all cheeses, this could be due to the fact that during the manufacture bacterial starter increase in number and continue to multiply for a few days afterwards whilst lactose is available in the cheese. For the remainder of the ripening period their number decreases (Foster *et al*., 1958).

Finally, it could be conclude that sensory evaluation of the Ras cheese manufactured with 0.5 % and 1% turmeric exhibited a more acceptable sensory evaluation than the cheese samples with higher turmeric concentrations. Turmeric could be used as a natural pigment in the dairy products that may help focus on its beneficial properties.

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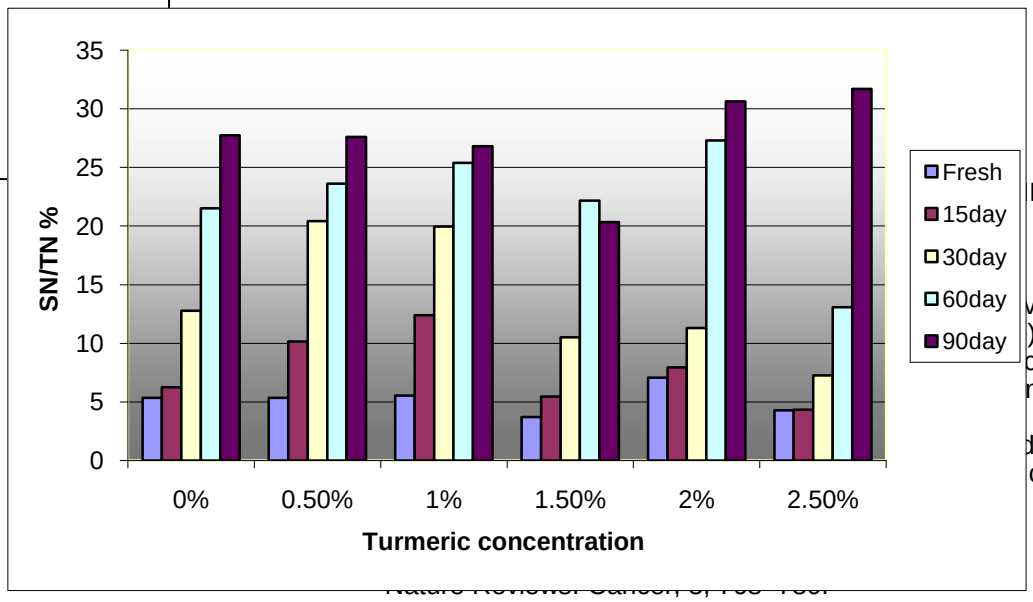

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إستخدام الكركم كمادة ملونة طبيعية فى صناعة الجبن الراس

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يحظي الكركم باهتمام بحثي كبير في الآونة الأخيرة نظرا لأهميته الطبية و خواصه الصناعية الهامة. ونظرا لكون نبات التيرميرك مادة ملونة طبيعية تحتوي علي الكركم كمادة فعالة فقد تم استخدامه في هذه الدراسة في تصنيع الجبن الراس بديلا عن مادة الأناتو في تركيزات متدرجة تشمل ٠%و ٠,٥% و ١% و١,٥% و ٢ % و٢,٥% علي الترتيب. وقد تم التصنيع والتسوية عند درجة حرارة ١٢±٢ مئوية ولمدة ٣ شهور. و تم عمل التحليل الكيميائي للجبن للرطوبة والدهن و الملح و الرقم الهيدروجيني و الحموضة والمحتوي النيتروجيني الكلي و النيتروجين الذائب والأحماض الدهنية الطيارة وكذلك التحليل الميكروبيولوجى للمعاملات. و تم عمل تقييم حسي للجبن الراس الطازج وشهريا أثناء التسوية. و قد أظهرت النتائج انخفاض مستوي الرطوبة مع ارتفاع في نسبة الملح في كل المعاملات و خاصة تلك التي تم تسويتها لمدة ثلاثة أشهر. وكانت متوسطات قيم الدهن و المحتوي النيتروجيني الكلي و النيتروجين الذائب و الأحماض الدهنية الطيارة ترتفع مع ازدياد تركيزالكركم في كل معاملات الجبن. و قد حظيت معاملات الجبن التي تحتوي علي تركيزات ٠,٥% و ١% من الكركم بتقييم الحسي مرتفع عن باقي معاملات الجبن ذات التركيز الأعلي من الكركم وذلك بالمقارنة مع معاملات الجبن المقارنة المصنوعة مع مادة الأناتو.

من هذه الدراسة نستخلص أن الكركم كصبغة ملونة طبيعية يمكن أن يتم استخدامه في منتجات الألبان و هذا من شأنه أن يبرز الخواص ذات الفائدة الطبية و الصناعية في مادة الكركم.

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