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The Influence of Malt Extraction Adding to UF Fresh Low Fat Cheese on Its Textural Properties

Zahra Shafiei¹, Mohammad Hojjatoleslami^{*1}, Sahel Soha², Mohammad Ali Shariati³

¹Department of Food Science and Technology, Faculty of Agriculture, Islamic Azad University, Shahrekord Branch, Shahrekord, Iran.

²Researcher of Institute of Standards and Industrial Research of Iran, Arak, Iran.

³Department of Food Science and Technology, Science and Research Branch, Islamic Azad University, Tehran, Iran.
Corresponding Author: mohojjat@iaushk.ac.ir

Abstract - Today, demands for reduced fat products such as reduced fat cheeses is growing as it has shown in other food products, however high nutritional value of milk fat as a functional food can't be ignored. This study deals with investigation of adding malt extract (in 4 different concentration 0.075, 0.1, 0.15 and 0.2 %) to ultra filtered cheese and comparing them with 2 control including a sample produced of milk containing 3.5 % fat and a 0.93 % fat and their rheological and textural properties evaluated at 3, 20, 40 and 60 days. Results indicate reduction of texture properties revealed. Rheological analysis exhibited the texture improvement by adding malt extraction; therefore this product can be used as an additive to ultra filtered cheese to enhance its texture.

Keywords—Model Low Fat Cheese, Texture, Malt Extraction, UF fresh cheese

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Introduction

UF fresh cheese has a soft, spreadable texture produced by ultra filtration of milk to reach 35 % dry solid and then enzyme coagulation of retentate. Two month shelf life, final pH 4.8, having 45-60 % fat in dry solid in final products are some properties of this cheese, therefore consuming it cause to increase the level of fat in consumers(1,3,15). Fat has both nutritional and textural role in cheese. And low fat cheeses contain deficits including hard and elastic texture, weak melt ability and inappropriate color and flavor(11) as a result of resulted more compressed protein matrix and more brittle cheese texture (10,16). To improve cheese texture, different ways are placed into 3 categories including modifying of usual technology of cheese making, application of suitable fat replacer to improve creaming texture and appropriate culture media which produce exopolysaccharides(16). Miocinovic et al. studied of using Inulin in low fat ultra filtered cheese and reported that low fat cheese without Inulin contained big holes while adding it caused to a creamy and compressed

texture (13). Applying Barley β -glucan concentrate as a fat replacer on physiochemical and functional properties of low-fat Mozzarella cheese exhibited more moisture and a softer texture in final products(20). Lobato-Calleros et al., used a complex of emulsion of different hydrocolloids such as Carboxymethyl cellulose, Arabic Gum and pectin. Among them CMC led to high fat texture-like properties in produced cheese (12). Adding malt extraction to Domiati cheese resulted in a slight increasing of moisture and acidity, more lypolyse and proteolyse along with more bacterial count overall flavor enhancement and textural properties of cheese(1). This study aims at improving technological and functional properties of low fat ultra filtered cheese by adding malt extraction.

Materials and Methods

To investigate of different concentration of malt extraction, six treatment produced and coded as follows: SFC: cheese produced by whole milk contains 3.5 % fat LFS: cheese produced by milk contains 0.93 % fat without malt extraction

- X1: cheese produced by milk contains 0.93 % fat and adding 0.075 % malt extraction
- X2: cheese produced by milk contains 0.93 % fat and adding 0.1 % malt extraction
- X3: cheese produced by milk contains 0.93 % fat and adding 0.15 % malt extraction
- X4: cheese produced by milk contains 0.93 % fat and adding 0.2 % malt extraction

Cow milk , malt extract and culture media FRC-65 purchased from Golpayegan city ,Isfahan province of Iran , ZgrosJahanbin Co and Chr, Hansens Dairy Cultures, Denmark respectively.FRC-65 culture media consists of Lactococcuslactis subsp. Cremoris Streptococcus thermophilus, Lactobacillus delbrueckii subsp. Bulgaricus. To create curd ,Fromase 2200 TL Granulate(D.M.S Co Australia) used.

UF Cheese Preparation

First, raw milk passed through, chiller,clarifier, bactofugationsystem , then pasteurized at 72°C for 15 s and its water , lactose and minerals removed by tubular membrane filters ,resulted retentate homogenized at 55 °c and 70 psi , pasteurized at 78 °c for 1 min , then cooled to 37 °c and inoculated by adding 1 % starter.Malt extract added in 5 levels including 0 , 0.075 , 0.1 , 0.015 and 0.2 to retentate. Retentate passed through curd tunnel (30 min , 30 °c), then placed in incubator at 25-30 °c for 24 hr. Produced samples placed in refrigerator 60 days at 8-10°C in order to investigate their textural properties .

Texture Profile Analysis (TPA)

Brookfield engineering, Middleboro, USA equipped with a TA 3/1000 probe was used to conduct TPA evaluation of Controls and treatments in 3,20 ,40 and 60 days of storing.Cheese samples cut into 20×20×20 mm, compressed to 50 % of initial height (10 mm) in 2 cycles .penetration rate was 0.5 mm /s and each test was performed in 3 replicates .the evaluated properties were Hardness , Cohesiveness, Springiness, Chewiness , Gumminess and Adhesiveness (5,7).To perform cutting test former device equipped with a TA /53 probe and required force to cut in depth of 15 mm measured .And each samples test performed in 3 replicates. A TA /40 probes used for punching test and the required force of punching metal rod in depth of 10 mm measured. Other conditions were the same as other tests (5).Results analyzed by ANOVA and Duncan tests by SPSS V.20 software.

Results and discussions

Hardness

Table 1 shows the TPA results of fresh samples. Hardness define as required force of compressing cheese between milling teeth (for hard and semi hard cheeses) or between tongue and palate (for soft and spreadable cheeses).Water, protein and fat influence hardness of cheese (18). Protein dominance in low fat cheese results in introducing more hardness and elastic like texture (14,16). The most and the least evaluated hardness wererelated to LFS and X4 respectively. Increasing malt

extract is thought to result in reduction of hardness (Fig 1). These results are in agreement with Romeih et al. (2002) and Koca et al. (2004). Moisture increased the plasticity of protein matrix and decreased its elasticity made it ready to be disrupted in compressing , entrapped water molecule inside of 3 dimensional protein matrix , therefore weaken and soften the texture.

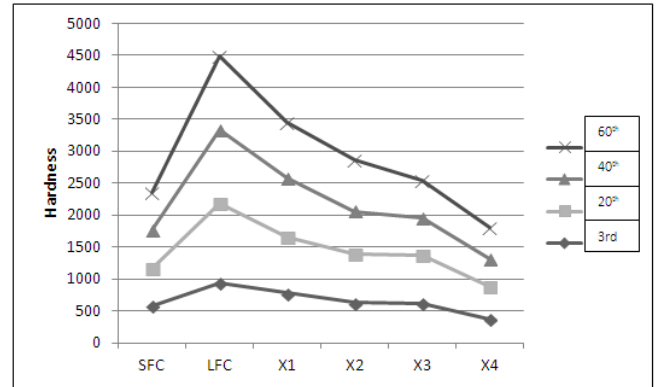


Fig.1.Effect of malt extract on hardness of UF fresh low fat cheese at 3rd , 20th , 40th and 60th days of storing

Cohesiveness

Cohesiveness define as the amount of created deformation by milling teeth compressing before cutting occurs, mostly depends on molecules links (5,7,19). The most and the least cohesiveness were related to LFS and SFC respectively (p<0.05) .it is thought that due to fat reduction (4,16,17).All the results are in agreement with Volikakis et al. (2004). Weakness of inside links is the main important reason of cohesiveness reduction observed in low fat cheese which deformed irreversibly by TPA device .This reduction also can increase proteolyses and softening of cheese.

Springiness

Springiness implies the elasticity of sample in which more springiness causes to more elasticity. The most amount of this parameter related to the low fat treatment (5,19). The most amount of springiness related to the low fat treatment .results were in agreement with Koca et al , 2004; Romeih et al ,(2002).It is found that malt extract resulted in moisture absorption , reduction of hardness and less ability to initial shape when removing force(15).

Chewiness

When fat reduced, chewiness increased significantly respect to SFC (in agreement with Volikakis et al.,2004).It is thought that more moisture content as a result of water binding by adding malt extract to cheese has been weakened the texture and decreased the required force of cracking samples(5,21,19).

Gumminess

Table 2 shows the results of Gumminess test.The amounts of Gumminess in LFC was significantly more than SFC (p>0.05).This results were in agreement with Romeih et al, 2000. More malt extract, less Gumminess in

produced cheese may arise from increasing moisture content 'cause of capacity of malt absorbing water (12,17,19).

The amount of adhesiveness increased by increasing fat content due to loosening of protein matrix and more water intake. Koca et al, (2004) found more cohesiveness in samples containing more fat (10). X4 showed the most cohesiveness.

Adhesiveness

Table.1.Comparison of averages of different malt extraction concentration on textural properties of UF fresh cheese

Samples	Parameter	Day			
		3	20	40	60
SFC	Hardness(gr)	580/75±31/75 ^b	577/66±89/39 ^a	600/75±2/75 ^b	597/75±55/25 ^a
	Cohesivene	0/24±0 ^a	0/22±0/062 ^a	0/21±0/015 ^a	0/19±0/025 ^a
	Spriniginess(mm)	5/96±0/10 ^a	7/51±0/83 ^{ab}	5/73±1/24 ^a	6/40±0/11 ^a
	Chewiness (gr)	8/15±0/26 ^a	9/81±5/30 ^a	7/41±2/17 ^a	7/16±0/070 ^a
	Guminess (gr)	139/60±6/80 ^a	129/46±55/36 ^a	129/60±10/70 ^{ab}	114/00±3/20 ^a
	Adhesiveness (gr)	0/46±0/26 ^{ab}	1/20±0/56 ^a	0/60±0/075 ^a	3/18±0/30 ^b
LFC	Hardness(gr)	945/37±3/62 ^d	1235±128/50 ^d	1146/66±165/68 ^d	1161/33±147/41
	Cohesivene	0/36±0/020 ^b	0/24±0/020 ^a	0/19±0/040 ^a	0/18±0/058 ^a
	Spriniginess(mm)	10/08±0/40 ^c	8/25±0/26 ^b	7/94±0/76 ^a	7/47±0/12 ^b
	Chewiness (gr)	34/92±3/24 ^d	23/42±0/31 ^c	17/55±3/55 ^c	15/49±3/92 ^b
	Guminess (gr)	341±52±17/47 ^c	289/60±5/30 ^b	229/36±64/81 ^{cd}	210/93±50/13 ^{bc}
	Adhesiveness (gr)	0/45±0/068 ^{ab}	0/66±0/035 ^a	1/07±0/92 ^a	0/85±0/0057 ^a
X₁	Hardness(gr)	777/00±47/50 ^c	883/00±64/00	921/00±63/00 ^c	875/00±24/50 ^b
	Cohesivene	0/36±0/010 ^b	0/29±0/0057 ^b	0/32±0/026 ^b	0/22±0/0057 ^{ab}
	Spriniginess(mm)	8/33±0/28 ^b	8/01±0/88 ^{ab}	6/30±0/36 ^a	7/27±0/23 ^b
	Chewiness (gr)	22/81±2/87 ^c	20/82±4/27 ^{bc}	18/41±3/25 ^c	14/06±0/18 ^b
	Guminess (gr)	278/25±25/65 ^d	262/00±25/40 ^b	296/43±35/32 ^d	197/40±8/90 ^c
	Adhesiveness (gr)	0/16±0/16 ^a	0/54±0/30 ^a	0/56±0/54 ^a	1/07±0/71 ^a
X₂	Hardness(gr)	626/50±30/45 ^b	765/00±13/00 ^{bc}	663/16±36/08 ^b	813/66±107/13 ^b
	Cohesivene	0/35±0/036 ^b	0/36±0/010 ^c	0/26±0/015 ^{ab}	0/32±0/026 ^c
	Spriniginess(mm)	7/86±0/90 ^b	7/80±1/27 ^{ab}	8/23±2/82 ^a	7/72±0/29 ^b
	Chewiness (gr)	17/21±3/83 ^b	21/16±3/68 ^{bc}	14/30±4/61 ^{bc}	19/82±3/26 ^c
	Guminess (gr)	221/36±25/58 ^b	276/10±3/20 ^b	178/13±11/85 ^{bc}	263/03±51/97 ^b
	Adhesiveness (gr)	0/44±0/13 ^{ab}	0/69±0/40 ^a	1/49±1/90 ^a	0/62±0/44 ^a
X₃	Hardness(gr)	622/00±43/89 ^b	744/83±24/87 ^b	590/83±59/03 ^b	581/50±98/00 ^a
	Cohesivene	0/34±0/047 ^b	0/30±0/011 ^b	0/23±0/072 ^a	0/27±0/030 ^{bc}
	Spriniginess(mm)	7/71±1/06 ^b	7/25±0/66 ^{ab}	7/29±0/64 ^a	6/01±0/75 ^a
	Chewiness (gr)	16/19±2/40 ^b	15/96±1/23 ^b	10/18±5/07 ^{ab}	9/32±1/81 ^a
	Guminess (gr)	214/40±14/86 ^b	241/56±40/92 ^b	139/30±57/98 ^{ab}	157/03±11/66 ^{ab}
	Adhesiveness (gr)	1/22±0/37 ^{bc}	0/29±0/14 ^a	0/10±0/092 ^a	0/22±0/025 ^a
X₄	Hardness(gr)	371/66±55/44 ^a	503/25±42/75 ^a	430/33±37/23 ^a	499/50±9/50 ^a
	Cohesivene	0/28±0/034 ^a	0/23±0/010 ^a	0/23±0/051 ^a	0/27±0/0057 ^{bc}
	Spriniginess(mm)	6/36±1/06 ^a	6/54±0/56 ^a	6/10±0/68 ^a	6/01±0/58 ^a
	Chewiness (gr)	6/66±2/38 ^a	7/40±1/04 ^a	5/78±0/68 ^a	8/08±0/77 ^a
	Guminess (gr)	104/40±21/57 ^a	114/73±6/50 ^a	97/46±15/10 ^a	137/20±0/30 ^a
	Adhesiveness (gr)	1/52±1/02 ^c	3/56±1/23 ^b	3/96±0/87 ^b	3/35±0/86 ^b

Similar letters describe no significant differences (p < 0.05)

SFC: cheese produced by whole milk contains 3.5 % fat

LFS : cheese produced by milk contains 0.93 % fat without malt extraction

X1 : cheese produced by milk contains 0.93 % fat and adding 0.075 % malt extraction

X2: cheese produced by milk contains 0.93 % fat and adding 0.1 % malt extraction

X3: cheese produced by milk contains 0.93 % fat and adding 0.15 % malt extraction

X4:cheese produced by milk contains 0.93 % fat and adding 0.2 % malt extraction

Punching

LFC's hardness was significantly more than SFC and other treatments (p>0.05).Adding malt extract to cheese cause to soften texture and less required force for penetrating. X4 had the least hardness among treatments (16,19).

Cutting

Table 2 displays the results of cutting test .as it has shown , the most and the least hardness observed in LFC (significantly differed from other treatments) and X4 respectively .

Table 2. Comparison of averages of different malt extraction concentration on textural properties of UF fresh cheese

Parameters	Sample	Day			
		3	20	40	60
Punching (gr)	SFC	b70/83±10/61	a64/00±2/00	b79/66±5/13	b74/66±1/25
	LFC	e114/5±4/92	d159/33±1/60	d118/83±3/75	d141/00±3/60
	X1	d102/00±1/50	c102/50±4/09	d110/16±9/82	c102/33±1/04
	X2	c83/33±4/61	c96/83±6/75	c95/16±3/40	c100/66±3/40
	X3	c81/83±5/34	b82/50±11/50	b79/50±7/05	b71/83±8/96
	X4	a54/00±4/00	b77/66±6/21	a59/00±2/78	a60/33±4/07
Cutting (gr)	SFC	a32/50±2/78	a32/16±0/76	a35/33±4/07	a32/83±1/60
	LFC	d109/83±5/57	d117/83±2/84	d111/00±7/93	d112/00±8/67
	X1	c97/33±2/02	c102/50±11/50	d104/00±2/64	c98/50±1/32
	X2	c91/66±5/68	c93/50±4/09	c92/66±3/25	c95/66±2/84
	X3	b70/33±3/40	b73/16±2/36	b70/00±5/26	b69/83±8/25
	X4	a38/00±5/63	a41/33±3/01	a39/00±3/77	a40/16±4/25

SFC: cheese produced by whole milk contains 3.5 % fat Similar letters describe no significant

LFS : cheese produced by milk contains 0.93 % fat without malt extraction

X1 : cheese produced by milk contains 0.93 % fat and adding 0.075 % malt extraction

X2: cheese produced by milk contains 0.93 % fat and adding 0.1 % malt extraction

X3: cheese produced by milk contains 0.93 % fat and adding 0.15 % malt extraction

X4:cheese produced by milk contains 0.93 % fat and adding 0.2 % malt extraction

Conclusion

The results of this research revealed that some textural properties of low fat UF cheese influenced by adding malt extract in which led to intake more water, followed by creating a decreasing rate of all TPA measured parameters including Hardness, Cohesiveness, Springiness, Chewiness, Gumminess, Punching, Cutting X4 showed the most resemble properties of SFC .therefore applying malt extract can produce cheese like properties.

Abbreviation

UF = Ultra Filtration

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