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Textural Profile Analysis of Burfi Prepared in Three Stage Scraped Surface Heat Exchanger

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Abstract: Burfi is very popular Indian dairy products. Three stage scraped surface heat exchanger is very popular for processing of high viscous products. Burfi was manufactured by adding sugar directly into preheated milk by varying scraper speed all three stages. The quality of Burfi was evaluated in terms of Textural Profile Analysis (TPA). Effect of scraper speed on the textural property of Burfi was checked in different 27 scraper speed combinations.
Keywords: Burfi, SSHE, Textural profile analysis, scraper speed

1. Introduction

Instrumental analysis of food texture has come of age as is evidenced by increasing application of various empirical and imitative methods towards measurement of texture of a variety of foods and food products in research and quality control. Due to their simplicity, versatility and precision, these methods aim at replacing the sensory texture measurements which is often time consuming and less reproducible. While these attempts have met with varying degrees of success, meaningful studies on psychorheology aspects of food products brining out significant interrelationship between sensory texture perception and instrumental measurement can potentially revolutionize the quality control programs lending them greater reliability together with simplicity. So there is a need to consider the interrelationship between sensory descriptors and Instron texture parameters of Burfi. The present investigation was proposed with objectives to evaluate textural properties of Burfi at different combination of scrapper speed of three stage scraped surface heat exchanger.

2. Materials and Methodology

Experimental set-up: The experimental set up shown in Figure 1 was three stage scraped surface heat exchanger developed by Dodeja et al. [1]. The system includes: Thin Film Scraped Surface Heat Exchangers, Variable speed drives, Balance Tank, Feed Pump, valves for steam supply and Instrumentation.

Selection of raw material

Milk: Fresh buffalo milk and Skimmed milk was procured from Experimental Dairy NDRI, Karnal. Standardization was done to 6% Fat and 9% SNF. Acidity was increased up to 0.18% LA

Sugar: Commercial grade white crystalline sugar purchased from local market has been used in this present investigation.

Burfi manufacturing method: The flow diagram of Burfi making is depicted in fig. 1.

Textural profile analysis

The sample of Burfi was evaluated for its textural attributes, using Texture Analyzer TA-XT2i (Stable Micro Systems, Godalming, Surrey, UK) fitted with a 25 Kg load cell. The product was subjected to application of force to a depth of 8.0 mm by a P 75 probe attached to the texture analyzer fitted with a 5 kg load cell.

Parameters measured consisted of hardness, adhesiveness, springiness, cohesiveness, gumminess, and chewiness by using the Texture Expert for Windows software version 1.20 (Stable Micro Systems).
The textural parameters were worked out from the force-time curve thus obtained for each sample with force experienced by the probe on Y-axis and time on X-axis.
The test conditions maintained were as under
Sample size: Cylindrical sample of 1 cm diameter and 1 cm height was used.
Compression: Burfi samples were compressed twice to 80 % of its height.
Load cell: 25 kg load cell was used.
Probe speed: A probe speed of 5 mm/sec, during pre-test and 2.5 mm/sec for test and post- test was used throughout the study.
Probe name: P 75
Testing temperature: All measurements were carried out at 25±1° C

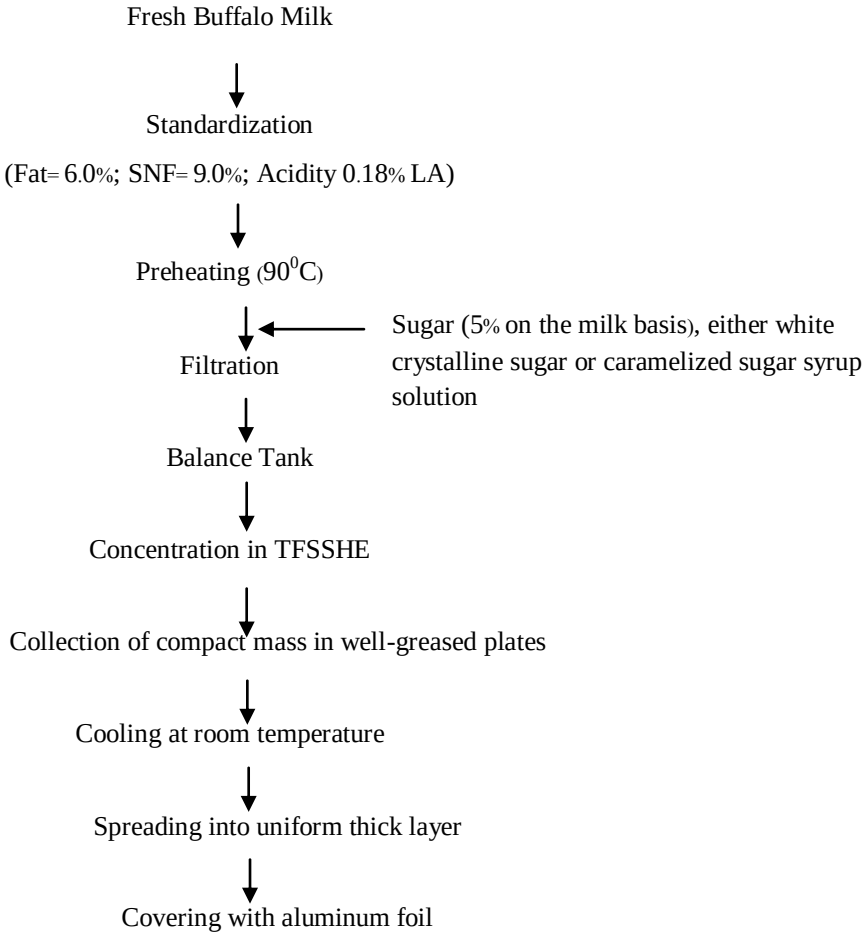

Fig. 1: Preparation of *burfi* in three stage thin film scraped surface heat exchanger

3. Results and Discussion

The Table 1 indicates trial codes with scraper speed, milk flow rate and steam pressure.

Effect of Scraper Speed on Texture Profile: The Table 2 indicates the textural profile data of the product in different trials.

Effect of Scraper Speed on Hardness: Hardness is the force required to compress a substance between teeth and is indicated by the highest value of force on the force-time curve during first compression cycle. The hardness value represents firmness of the product and ease with which it will spread (Patel et al., 2017).It is evident that as third stage scraper speed increases hardness decreases. This may because as third stage scraper speed increases, the residence time of the product within the system decreases, resulting in higher moisture content hence lowers hardness of the final product. As first or second stage rpm increases hardness also increases. It can be observed from graphs that hardness is higher for higher scraper speed of previous stage. It is because of higher steam pressures and higher scraper speed results to higher evaporation rates hence lowers the moisture content leading to harder product. The hardness of burfi varied from 24.97 N to 82.07 N with a mean value 48.88 N.

Table 1: Trial codes with scraper speed and steam pressure

Trial Code	Milk flow rate (kg/h)	Scraper speed (rpm)			Steam Pressure (kg/cm^2)		
		1st Stage	2nd Stage	3rdStage	1st Stage	2nd Stage	3rdStage
T 1	205	200	200	25	4	2	1.6
T 2	205	200	200	20	4	2	1.6
T 3	205	200	200	15	4	2	1.5
T 4	200	200	175	25	4	2	1.7
T 5	200	200	175	20	4	2	1.6
T 6	200	200	175	15	4	2	1.6
T 7	195	200	150	25	4	2	1.9
T 8	195	200	150	20	4	2	1.8
T 9	195	200	150	15	4	2	1.6
T 10	200	175	175	25	4	2	1.8
T 11	200	175	175	20	4	2	1.7
T 12	200	175	175	15	4	2	1.6
T 13	190	175	150	25	4	2	1.8
T 14	190	175	150	20	4	2	1.7
T 15	190	175	150	15	4	2	1.7
T 16	175	175	125	25	4	2	2
T 17	175	175	125	20	4	2	2
T 18	175	175	125	15	4	2	1.9
T 19	185	150	175	25	4	2	1.6
T 20	185	150	175	20	4	2	1.6
T 21	185	150	175	15	4	2	1.6
T 22	170	150	150	25	4	2	2
T 23	170	150	150	20	4	2	1.9
T 24	170	150	150	15	4	2	1.9
T 25	155	150	125	25	4	2	2
T 26	155	150	125	20	4	2	2
T 27	155	150	125	15	4	2	1.9

Effect of Scraper Speed on Gumminess: Gumminess was defined as the product of hardness and cohesiveness [2]. In other words gumminess is the energy required to disintegrate a semisolid food to a state ready for swallowing, indicates the denseness that persists throughout mastication. It is evident that as third

stage scraper speed increases gumminess decreases. As first or second stage scraper speed increases gumminess also increases. It can be observed from graphs that gumminess is higher for higher rpm of previous stage. This may because gumminess is product of hardness and cohesiveness hence gumminess varies in direct relation to hardness. The gumminess varied from 4.07 to 15.68 with a mean value 7.78.

Effect of Scraper Speed on Chewiness: Chewiness was defined as the product of gumminess and springiness (i.e. hardness x cohesiveness x springiness) [2]. Chewiness is an important textural attribute of solid food materials.It is evident that as third stage scraper speed increases chewiness decreases. As first or second stage scraper speed increases chewiness also increases. It can be observed from graph that chewiness is higher for higher scraper speed of previous stage. This may be due to fact that chewiness is directly related to hardness so it shows same trends as hardness shows. The chewiness varied from 1.12 to 2.88 with a mean value 1.84.

Effect of Scraper Speed on Adhesiveness, Springiness and Cohesiveness: It is evident that no particular trend is observed between scraper speed and these properties. Hence we may assume adhesiveness, Springiness and Cohesiveness to be uncorrelated to scraper speed. The values of adhesiveness, Springiness and Cohesiveness varied from -1.57 N.s. to -0.21 N.s., 0.072 to 0.64 and 0.065 to 0.427 respectively.

4. Conclusion

The values of hardness, gumminess and chewiness significantly affected by different combinations of operating parameters and all others textural characteristics have no significant trends.

Table 2: Effect of scraper speed on textural profile of the Burfi

Trial Code	Texture Profile Analysis						
	Hardness (N)	Adhesiveness (N.s)	Springiness (1)	Cohesiveness (1)	Gumminess (1)	Chewiness (1)	Resilience (1)
T 1	67.70	-0.539	0.328	0.101	4.078	1.327	0.064
T 2	75.37	-0.55	0.078	0.142	4.978	1.137	0.064
T 3	82.07	-0.505	0.178	0.242	5.578	1.397	0.064
T 4	54.95	-1.053	0.344	0.163	13.986	1.809	0.103
T 5	64.95	-1.023	0.374	0.113	14.286	2.509	0.103
T 6	71.95	-1.153	0.544	0.193	15.686	2.879	0.103
T 7	45.75	-0.29	0.149	0.21	11.578	1.823	0.122
T 8	50.75	-0.329	0.129	0.41	12.578	2.023	0.122
T 9	61.75	-0.209	0.109	0.201	12.978	2.423	0.122
T 10	53.94	-1.267	0.233	0.165	7.252	1.695	0.142
T 11	55.94	-1.207	0.283	0.175	7.952	1.895	0.142
T 12	65.94	-1.567	0.533	0.065	9.952	2.695	0.142
T 13	49.35	-0.405	0.124	0.209	7.058	1.658	0.117
T 14	52.07	-0.782	0.072	0.137	7.993	1.855	0.061
T 15	62.07	-0.782	0.072	0.137	8.693	2.25	0.061
T 16	30.48	-0.243	0.293	0.157	4.881	1.362	0.054
T 17	36.48	-0.269	0.093	0.127	5.591	1.662	0.054
T 18	42.48	-0.469	0.193	0.427	5.991	1.862	0.054

T 19	27.35	-0.682	0.235	0.18	5.124	1.784	0.076
T 20	34.35	-0.682	0.235	0.18	5.994	1.94	0.076
T 21	48.71	-0.225	0.095	0.202	7.043	2.376	0.115
T 22	25.35	-0.682	0.235	0.18	4.624	1.384	0.076
T 23	31.35	-0.792	0.405	0.119	5.624	1.84	0.076
T 24	41.71	-0.265	0.195	0.132	6.143	1.966	0.115
T 25	24.97	-0.627	0.635	0.238	4.24	1.124	0.076
T 26	28.05	-0.602	0.635	0.108	4.824	1.34	0.076
T 27	34.00	-0.225	0.095	0.202	5.303	1.766	0.115

References

[1] Anon, 2007, Managing growth is the challenge. In: Dairy India 2007, 6th Edn. Dairy India Yearbook, New Delhi: 15-42.
[2] Bourne M C (1978). Texture profile analysis. Food Tech., 32(7): 62-66, 72.

