Effect of foam drying method on the yield and quality of yoghurt powder

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Abstract:

This study examined the effect of adding egg white on the chemical, microbiological, and sensory properties of probiotic yogurt powder produced by fermenting milk with bacterial cultures, Streptococcus thermophillus and Lactobacillus bulgaricus. This study aimed to determine the foaming agent concentration needed to produce the best quality yogurt powder. Two concentrations of egg albumin used as the foaming agent: 20% and 30%. The yogurt foam dried at 50°C for 3 hours in a cabinet dryer. The results showed that the quality characteristics of probiotic yogurt powder with the addition of 20% egg white concentration were superior compared to the other concentrations. The yield percentage of the second treatment was: 19.40%, ash content 4.71%, moisture content (water content) 6.13%, acidity level (lactic acid) 1.57%, fat content 15.44%, protein content 24.48%, calcium 5120.53 ppm, phosphorus 643.49 ppm, and total bacterial count of lactic acid bacteria 9.08 log (colony forming unit/g). By studying the sensory characteristics of treatment T2, it was the best among the treatments in terms of flavor, texture, feel and appearance.

Keyword: yoghurt powder, foaming agent, egg albumin,

المستخلص

تاثير طريقة التجفيف بالرغوة على إنتاجية وجودة الزبادى المجفف نبيل بسيونى الجمل و فتحى أنور عبد المالك وإبراهيم شعبان أبو شريف قسم كيمياء الالبان - معهد بحوث الإنتاج الحيوانى - مركز البحوث الزراعية - مصر اهتمت هذه الدراسة بتأثير إضافة بياض البيض على الخصائص الكيميائية والميكروبيولوجية والحسية لمسحوق الزبادي (الزبادي المجفف) بمحتواه من االبروبيوتيك المُنتج عن تخمير الحليب باستخدام مزارع بكتيرية، Streptococcus thermophillusو Lactobacillus bulgaricus.وقد هدفت هذه الدراسة إلى تحديد تركيز مادة الرغوة لإنتاج أفضل جودة لمسحوق الزبادي. تم استخدام تركيزين من ألبومين

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البيض كعامل رغوة: وهى ٢٠% و٣٠%. جُففت رغوة الزبادي عند درجة حرارة ٥٠ درجة مئوية لمدة ٣ ساعات في مجفف . وأظهرت النتائج أن خصائص جودة مسحوق الزبادي المحتوى على البروبيوتيك مع إضافة تركيز بياض البيض بنسبة ٢٠% هى الاقضل بالمقارنة بالنسبة الاخرى . حيث كانت نسبة كمية المحصول الناتج من المعلملة الثانية هى: % ١٩.٤٠ %، ومحتوى رماد ٤.٧١%، ومحتوى الرطوبة (محتوى المائى) ٦.١٣ %، ومستوى حموضة (حمض اللاكتيك) ١.٥٧%، ومحتوى الدهن ١٥.٤٤%، ومحتوى البروتين ٢٤.٤٨%، وفوسفور ٦٤٣.٤٩ جزء في المليون، وكالسيوم ٥١٢٠.٥٣ جزء في المليون، والعد البكتيرى الكلى لبكتيريا حمض الاكتيك ٩.٠٨ لوغاريتم (وحدة تشكيل مستعمرة/جم). وبدراسة الخصائص الحسية للمعاملة T2 كانت الأفضل من بين المعاملات من حيث النكهة والقوام والملمس والمظهر.

Introduction

Yoghurt is the most popular fermented milk product in the world, and its consumption has increased due to consumer concern about healthier foods. Although yoghurt is an alternative to milk preservation, its shelf life is still short compared to other dairy products, such as certain types of cheese. Additionally, its nutritional value also makes the product susceptible to the development of certain spoilage microorganisms. Yoghurt powder has a long shelf life, expand the storage temperature range and simplifies the disruption process. Low moisture content of previously made into foam first by adding a foaming agent. The foaming agent functions to speed up drying, and reduce moisture content).

The foam concentration will increase the surface area and give a porous structure to the material. Therefore, it will increase the drying speed and the coating on drying foam will dry faster than without foam (Mulyoharjo 1988), yoghurt powder could prevent contamination from other microbes. One of the drying method that can be used for producing yoghurt powder is by foam-mat drying method. This method is drying liquid from the material. Yoghurt is one of dairy products produced from

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fermentation milk using lactic acid bacteria i.e. Streptococcus thermophilus, Lactobacillus bulgaricus, have already established their health benefits through their content of (Bugros et al 2020).

This study aims to carry out an upgrade of the drying technologies applied to yoghurt manufacture, including the quality parameters of the yoghurt powders and the effects of the drying processes on the lactic acid bacteria and increase the self-live of yoghurt powder by months.

Material &methods

This study carried out at the farm of the Sakha Animal Production Research Station, Animal Production Research Institute, Agricultural Research Center, and the Ministry of Agriculture. Cow milk contained 3.00% fat, 3.18% protein, 4.46% lactose, 8.10% solid not fat, and 11.34% total solids (milko-scan, model 133B) ,yoghurt starter from bacteria Streptococcus thermophillus ENCC 0040, Lactobacillus bulgaricus ENCC 0041

Liquid yoghurt processing.The composition of liquid yoghurt processing includes fresh cow's skim milk, this composition then pasteurized at a temperature of 85-90 ° C for 30 minutes, and cooled to 40-45 °C. After that inoculated with 2-3% starter and incubated at 45 °C for 4 hours.

Yoghurt powder

Egg white added into liquid yoghurt. The egg white concentration treatment used were 0%, 20%, and 30%, then, mixed using a mixer at high speed for ± 7 minutes.

The foamed yoghurt poured into a baking pan, spread using a spatula throughout the surface, and dried using a cabinet drying at 50°C for 3 hours. Dry yoghurt then cooled and crushed using a blender until it became yoghurt powder.

Analysis of yoghurt powder produced included, yield was determined according to standard methods of A.O.A.C. (٢٠٠٥).

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Behind storage of yoghurt powder rehydration analysis, microbiological,

Total viable bacteria evaluated according to Houghtby et al (1992). Calcium by flam photometer and phosphorus by spectrophotometer carried out according to Cottenie et al. (1982).

Sensory Evaluation

The organoleptic properties of the resultant cheese were assessed by a test panel of 10 persons at the Sakha Animal Production Research Station, Animal Production Research Institute, according to the scheme described by Nelson and Trout (1981).

Statistical Analysis

Results statistically analyzed by away complete design to study the effect of treatment using SAS (2004). However, the significant differences among means were tested using Duncan's Multiple Range Test Duncan, 1955).

Results and discussions Chemical characteristics of yoghurt powder Yield of yoghurt powder

The yield is due to the economic value of a product. The results analysis in Table showed that the treatment T3 obtained a higher yield than other treatments due to the addition egg white of caused total solids and yield to to increase. The difference addition of concentration used in the Treatment due to egg white foam treatments can protect microbes from heating. The yield during storage was little effect. The results of chemical analysis are presented in Table 1.The results showed that the addition of 20% egg white foaming agent (T2) produced the lowest moisture content of 6.13 ± 0.10%. It supposed that more egg white foam added, obtained the material more porous and the water would more easily be evaporated. However, in T3 there was slightly an increase in water content of 6.80 ± 0.01%. In accordance with

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(Zayas, 1997), it was suspected that most of the egg white contains protein and water, so the higher concentration of egg white will cause higher water content in yoghurt powder. The highest protein content found in the addition of egg whites 30% (T3) that is 25.16 ± 0.02%.

The higher concentration of egg white addition will increase the protein content of yoghurt powder. While in the T1, T2 samples, there a decrease in protein levels. Based on the results of the analysis showed that the addition of the egg white foaming agent reduced the fat content. From the results of the fat content analysis, this known that there was a decrease in fat content in the probiotic yoghurt powder produced. In accordance with (Nurilmala, 2008) that protein content in yoghurt powder probiotic will be inversely proportional to fat content. The decrease in fat content in yoghurt powder , also caused by the addition of hydrocolloid ingredients so that it will reduce the proportion of initial fat content.

Lactic acid content in samples met the requirements of acidity level (lactic acid) in yoghurt, according to (Badan Standarisasi Nasional 2009), ranging from 1.57-2.25%, showed in Table 2 that the Lactic acid content Decreasing acidity in treatments are suspected due to the addition of egg white. The carbohydrate content serves as a carbon source for lactic acid bacteria in the fermentation process. Therefore, the formation of organic acids, particularly lactic acid, from the breakdown of carbohydrates by bacteria was also higher. Low ash content in sample T3, the resulting ash content in table 2 was relatively low. Whereas in theT3 sample there was an additional mineral from egg white so that resulting ash content becomes higher. According to (Direktorat Gizi Departemen Kesehatan RI 1989), some of the minerals contained in eggs include the (iron, phosphorus, and calcium).

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Table (1): Yield and chemical properties of yoghurt powder at storage periods.

Properties%	Storage	Treatments*			Main±SR
		T1 control	T2 (20% egg)	T3 (30% egg)	
Yield	1	18.50±0.07	19.53±0.07	20.10±0.1	19.38±0.01 A
	2	18.50±0.07	19.53±0.07	20.33±0.1	19.46±0.01 AB
	3	18.6±0.07	19.20±0.07	20.13±0.1	19.11±0.01 B
	4	18.17±0.07	19.33±0.07	20.40±0.1	19.30±0.01 B
Main±SR		18.44±0.03 c	19.40±0.03b	20.24±0.03a	
Motiure	1	6.5±0.1	6.26±0.1	6.70±0.1	6.49±0.1A
	2	6,7±0.1	6.20±0.1	6.73±0.1	6.54±0.1A
	3	6.7±0.1	6.30±0.1	6.73±0.1	6.58±0.1A
	4	6.6±0.1	6.13±0.1	6.80±0.1	6.52±0.1A
Main±SR		6.62±0.03b	6.22±0.03c	6.74±0.03a	
Protein	1	24.46±0.02	24.45±0.02	24.66±0.02	24.46±0.02 A
	2	23.46±0.02	24.53±0.02	25.12±0.02	24.45±0.02 A
	3	23.50±0.02	24.45±0.02	25.15±0.02	24.50±0.02 A
	4	23.45±0.02	24.46±0.02	25.20±0.02	24.45±0.02 A
Main±SR		23.47±0.02 c	24.48±0.02b	25.16±0.02a	
Fat	1	15.23±0.1	15.22±0.1	14.21±0.1	14.89±0.01 A
	2	15.20±0.1	15.40±0.1	14.20±0.1	14.93±0.01 A
	3	15.76±0.1	15.50±0.1	14.33±0.1	14.96±0.01 A
	4	16.20±0.1	15.46±0.1	14.21±0.1	15.29±0.01 A
Main±SR		15.22±0.03 a	15.44±0.03a	14.24±0.03a	

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* T1: control yoghurt without egg white, T2: Added 20% egg white and T3: with 30% egg white.

abcd: Means with different letter among treatments in the same raw are significantly different, and ABCDLetters indicate significant differences between storage periods of yoghurt.

Table (2): Physicochemical properties of yoghurt powder at storage periods.

Properties %	Storage (months)	Treatments*			Main±SR
		T1 control	T2 (20% egg)	T3 (30% egg)	
acidity	1	2.25±0.01	1.57±0.01	1.65±0.01	1.82±0.01A
	2	2.24±0.01	1.58±0.01	1.66±0.01	1.83±0.01A
	3	2.26±0.01	1.57±0.01	1.66±0.01	1.83±0.01A
	4	2.23±0.01	1.57±0.01	1.67±0.01	1.83±0.01A
Main±SR		2.25±0.01 a	1.57±0.01 c	1.66±0.01 b	
ash	1	4.78±0.02	4.71±0.02	4.74±0.02	2.41±0.02D
	2	4.79±0.02	4.72±0.02	4.63±0.02	5.57±0.02C
	3	4.77±0.02	4.72±0.02	4.72±0.02	7.58±0.02B
	4	4.76±0.02	4.68±0.02	4.72±0.02	11.45±0.02 A
Main±SR		4.78±0.01 a	4.71±0.01 b	4.70±0.01 b	

* T1: control yoghurt without egg white, T2: Added 20% egg white and T3: with 30% egg white.

abcd: Means with different letter among treatments in the same raw are significantly different, and ABCDLetters indicate significant differences between storage periods of yoghurt.

Results analysis of calcium (Ca) and phosphorus (P) levels were presented in Table 3.The high level of calcium (Ca) in T2 treatments (5120.53 ±0.02percentage) and not significantly different among other treatments, but different with T treatments. The addition of egg white foaming ingredients, which contain calcium of 6 mg (Direktorat Gizi Departemen Kesehatan RI 1989), could be increase Ca content in yoghurt powder. The

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highest phosphorus levels in treatment (T2) 643.69 ±0.02 percentage but were relatively not significantly different with other treatments. It was known that. Cow's milk had a high phosphorus content of 694 mg/100 g, but this a little is dried. (Direktorat Gizi Departemen Kesehatan RI 2005) that may cause phosphor content high enough in the yoghurt powder.

Table (3): Calcium and Phosphorus of yoghurt powder at storage periods.

Properties%	Storage (months)	Treatments*			Main±SR
		T1 control	T2 (20% egg)	T3 (30% egg)	
Calcium	1	5031.02±0.01	5120.12±0.02	5065.36±0.02	5205.50±0.02C
	2	5031.01±0.01	5120.16±0.02	5065.63±0.02	5205.60±0.02b
	3	5031.02±0.01	5120.90±0.02	5065.95±0.02	5205.91±0.02A
	4	5031.04±0.01	5120.94±0.02	5065.73±0.02	5205.96±0.02A
Main±SR		5031.02±0.01c	5120.53±0.02a	5065.67±0.02	
Phosphorus	1	600.68±0.01	643.25±0.02	468.54±0.03	671.49±0.02B
	2	655.876±0.01	643.45±0.02	468.66±0.03	671.66±0.02A
	3	602.94±0.01	643.55±0.02	468.69±0.03	671.30±0.02A
	4	699.67±0.01	643.69±0.02	468.85±0.03	671.74±0.02A
Main±SR		639.80±0.01a	643.49±0.02b	468.68±0.03c	

* T1: control yoghurt without egg white, T2: Added 20% egg white and T3: with 30% egg white.

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Total lactic acid bacteria according to Badan Standarisasi Nasional (2009), yoghurt must have a minimum starter bacteria content of log (cfu / ml). Table 4 presented the results of microbiological analysis of yoghurt powder the table 4 showed the viability of lactic acid bacteria found in yoghurt powder and after rehydration of yoghurt, powder. Table 4 showed that the addition of 20% egg whites (T2) had the highest viability of log 9. 08 (cfu\ g).Egg white with the right concentration can protect bacteria. Egg white foam contains a type of albumin protein such as ovalbumin (54%), ovomucin (11%) and other proteins (17%) which can protect heat-sensitive materials such as bacteria or microbes (Stadelman and Cotteril 1995).

Ovalbumin can form strong foam, so can be protected to heat-sensitive material from damage. Ovomucin serves to stabilize foam. While other proteins such as ovoglobulin can increase viscosity, strengthen the binding of air bubbles and soften the resulting foam texture. Nevertheless, the addition of egg white foam too high (T3) can reduce bacterial viability to 8.40cfu/g due to egg white foam that protects bacteria too strong so that bacteria cannot synthesize their food. Therefore, the bacteria will not get enough energy for their lives and become death. However, T treatments showed low bacterial viability, suspected that capability of egg white as foaming agent better than other treatments the bacterial viability. The viability of LAB is increase in rehydration yoghurt in all treatments. It was because the when rehydration process, there was the addition of skim milk which serves as a nutrient for growth and microbial activity.

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Table (4): log total lactic acid bacteria in yoghurt powder and Log lab in rehydration yoghurt at storage periods.

Properties %	Storage (months)	Treatments*			Main±SR
		T1 control	T2 (20% egg)	T3 (30% egg)	
Log lab /g in yoghurt powder	1	8.73±0.03	9.19±0.01	8.87±0.02	8.93±0.02 A
	2	8.62±0.03	9.11±0.01	8.26±0.02	8.67±0.02B
	3	8.55±0.03	9.02±0.01	8.26±0.02	8.61±0.02C
	4	8.40±0.03	8.99±0.01	8.19±0.02	8.54±0.02 D
Main±SR		8.58±0.03 b	9.08±0.01a	8.40±0.02c	
Log lab in rehydration yoghurt	1	10.03±0.01	12.57±0.01	10.98±0.01	11.19±0.01 B
	2	10.32±0.01	12.52±0.01	10.87±0.01	11.24±0.01 A
	3	10.34±0.01	12.23±0.01	10.64±0.01	11.07±0.01 C
	4	10.22±0.01	12.23±0.01	10.52±0.01	10.95±0.01 D
Main±SR		10.23±0.01c	12.36±0.01a	10.75±0.01 b	

* T1: control yoghurt without egg white, T2: Added 20% egg white and T3: with 30% egg white.

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Table (5): Sensory evaluation of yoghurt powder at storage periods

Properties%	Storage (months)	Treatments*			Main±SR
		T1 control	T2 (20% egg)	T3 (30% egg)	
Flavor (50)	1	45	44	39	42
	2	44	43	38	41
	3	43	42	37	40.2
	4	41	41	35	38.6
Main±SR		43.5±0.02	42.5±0.02	37.25±0.02	
Body &texture(40)	1	36	35	30	33.67
	2	36	37	30	33.33
	3	35	34	29	32.33
	4	34	32	29	31.67
Main±SR		35.5±0.02	34.5±0.02	29.5±0.02	
Apperance(10)	1	10	9	7	8.33
	2	9	9	6	7.67
	3	8	9	5	7.00
	4	8	7	5	6.33
Main±SR		8.75	8.5	5.75	
Total(100)	1	91	84	76	80.67±0.02A
	2	89	83	74	82.00±0.02A
	3	85	80	71	78.67±0.02B
	4	84	77	69	76.67±0.02C
Main±SR		87.75±0.02a	85.5±0.02a	72.5±0.02b	

* T1: control yoghurt without egg white, T2: Added 20% egg white and T3: with 30% egg white.

abcd: Means with different letter among treatments in the same raw are significantly different, and ABCDLetters indicate significant differences between storage periods of yoghurt.

The results of sensory evaluation are product yoghurt powder values of flavor,

body & texture, appearance and total as adjudged by a panel showed in Table (5). The flavor, body & texture, appearance and total scores Organolepetical of treatment (T 2) added 20 egg

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white the best than treatment 3 in flavour, body, and total Sensory and thought stage of storage the fest month was the best of other months. The total score of organoleptic properties in treatments were 87.75, 85.5, and 72.5 respectively T1, T2, and T3 and the best treatment was T2.

Conclusion

The quality of probiotic yoghurt powder with the addition of egg whites concentration of 20% had met the requirements of SNI for liquid yoghurt. The characteristic were yield of 19.53%, ash content of 4.71%, water content of 6.29%, acidity level (lactic acid) 1.57%, fat content 15.44%, protein content 24.48%, phosphorus (P) 643.49 ppm, calcium (Ca) levels 5120.53 ppm, total bacteria lactic acid 9.08 log (cfu/g). Sensory properties of the treatment T2 was best of other treatments.

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