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QUALITY AND SHELF LIFE PROPERTIES OF YOGHURT FORTIFIED WITH CANNELLINI BEANS POWDER (*Phaseolus vulgaris L*.)

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ABSTRACT

Yoghurt was mad from cow's milk fortified with 2%skim milk powder (control).the skim milk powder was substituted with cannellini beans powder in four variants of yoghurt by using 25 , 50, 75 and 100 % in order to increase the nutritional value of the product. Control and treated variants of yoghurt was made by the conventional method . chemical, microbiological or rheological as well as Organoliptic properties were carried out . yoghurt fortified with 75%of skim milk powder was found the best treatment chemical, microbiological ,rheological and Organoliptic properties.
Keywords: Yoghurt, fermented milk, Cannellini beans , White beans and *Phaseolus vulgaris L*.

INTRODUCTION

There has been an increase in the production of fermented milks in the developed countries .Yoghurt is a very popular flavorful and healthful dairy product in Egypt. Its production and consumption is growing continuously due to its therapeutic properties, beside its high nutritive value (Karagul *et al*., 2004).The health promoting properties of live lactic acid bacteria in yoghurt include protection against gastrointestinal upsets, enhanced digestion of lactose by maldigesters , decreased risk of cancer, lower blood cholesterol, improved immune response and help the body assimilate protein, calcium and iron (Perdigeon *et al*., 1998; Marona and Pedrigon, 2004). Cannellini beans(White beans) are loaded with nutrients the body needs. They help reduce cholesterol, prevent headaches .These beans are low-fat, high in fiber and provide a high quality of magnesium, fiber, iron and folic acid(Susan M. Shutler *et al*.,1989; Devanand L. Luthria 2006; Donna M. Winham 2007 and John Shi 2009) .

MATERIALS AND METHODS

Fresh cow’s milk was obtained from Dairy Department, faculty of agriculture, Mansoura University, El Mansoura. the analysis of cow's milk was T.S :14.3%, Fat 4.4% ,T.P 3.3%,pH 6.7 and Acidity 0.14 % .
Skim milk powder used in this work was made in Poland by " VARIMEX".
Moisture:4% Fat: 1.25%
Cannelline beans was purchased from the local market.
yoghurt starter powder (*S. Thermophilus* and *L. delbruckii* subsp. *bulgaricus*) were obtained from Hansen Laboratories – Denmark, and kept under suitable conditions until use .

All the chemicals used for different analyses in this study were of the highest purity.

Fresh milk fortified with 2% of skim milk powder(control) and the variants being made from cow's milk fortified with different concentrations of cannellini beans powder instead of skim milk powder were used in making the examined yoghurt . milk (in control and the examined variants was heated to 90°C for 5 min then cooled to 40°C. All portions were inculcated with 3.0% yoghurt starter (S. Thermophilus and L. delbrueckii sub. Sp. bulgaricus) then incubated at 41°C until the end of incubation period . The obtained yoghurt was stored in refrigerated conditions for 14 days. Samples were taken for Organoliptic, chemical and microbiological analysis at zero time and after , 7and 14 days ,respectively.

Ten trained panelists from the staff members of the Dairy Department of Faculty of Agriculture, mansoura University evaluated of each yoghurt sample and used a quality rating score card for evaluation of flavor (50 points) and body and texture (40 points) and appearance (10 points) as described by farahat *et al*. ,(1974).

Yoghurt samples were examined for fat%, total solid content and titratable acidity according to AOAC (1990). Total nitrogen %,non protein nitrogen and soluble nitrogen content using Kjeldahl method according to Kuchroo and Fox (1982) and IDF 1993). Total volatile fatty acids (TVFA) were determined by the distillation method described by Kosikowski (1982). Curd tension and rate of curd syneresis were measured as described by EL-Shabrawy (1973) and Mehanna and Mehanna (1989).Yoghurt pH values were by using an Orion Research pH-meter standardized with pH 4 and 7 standard buffer solutions.

Microbiological analysis: Yoghurt samples were prepared according to the method recommended by ICMSF (1996) and analyzed at zero and after ,7,14 days of storage at 4˚C.

Lactic acid bacteria was determined using L.A.B medium as described in the standard methods for examination of dairy products (SMEDP, 1985). The plates were incubated at 32±1°C for 2 days.

Staphylococcus sp. was counted by using staphylococcus medium 110. The plates were incubated at 37°C for 24-36 hrs and examined for orange colonies.

Coliform bacteria were counted by using macKonky agar, which was prepared by using 48 g / liter. The plates were incubated at 37°C for 24 hours.

Moulds and yeasts were counted by using potato dextrose agar medium acidified to pH 3.5 with sterile lactic acid (37%). The plates were incubated at 22°C for 72 hours.

RESULTS AND DISCUSSION

Data indicated in Table (1) illustrate the changes in pH values and shows that there was an increase in these values with the increasing of the ratio of cannellini beans powder. With the progress in the storage period the pH values decreased until 7 days followed by an increase until the end of

storage period . This might be due to the analysis of protein and the presence of protein fractions, which cause is an alkaline effect in yoghurt media. In addition, the acid content of all treatments were lower than that in the control yoghurt. also, It could be noted that acid content of all treatments and control yoghurt gradually increased with the progress of storage period. Moreover, the acid content of all treatments were in an inverse trend with the increase of cannellini beans powder ratio. So, the treatment (I) contained the highest acidity (1,87%) compared with the other variants than and was near from the control. These results might indicate an exhibiting effect of cannellini bean powder on the starter microflora. The progress in acidity appeared in control cheese followed by treatment 1 (25 % cannellini bean powder). On the other hand, acidity of other treatments decreased after 7 days of storage period, and this confirms the effect of cannellini bean powder on starter flora on yoghurt, especially, at high concentration, and this effect appears with the progress in storage period. These results are in agreement with the finding of Gad El-Rab *et al*. (1995).

Data in Table(1) show the changes in the total solids (T.S%) content of yoghurt fortified with skim milk powder (control) and different ratios of cannellini bean powder instead of skim milk powder. These data indicate that there was trivial differences in (T.S %) among all treatments and control yoghurt. This might be resulted from converting some of free water to bound water as a result to the presence of fiber content. All treatments and control yoghurt contained an increase in (T.S %) content during the storage period, Treatment (4) was of the highs (T.S %) content either in fresh or during storage periods. These results might be due to the loss of some moisture content during storage, and the binding ability of the fiber in cannellini beans powder, which increases the total solids content in all treatments, except control yoghurt. The data in the same Table indicate the changes in the fat content in fresh and stored product. These data reveal great differences among treatments or control, and this might be resulted from the rapprochement in the fat content of skim milk and cannellini bean powder, Fat/dray matter decreased with the increase of cannellini bean powder ratio. On the other hand, there were trivial increase in the fat content in all treatments with the progress of storage period. This might be due to the correlation between the increase in the total solids content and fat increasing. Also, slight differences in the Fat/ dray matter ratio occurred in all treatments during the storage period, in addition, the treatment 4 (T4) contained the lowest fat/ dray matter(28.2) content among other treatments either as fresh or stored product .

Data in Table (1) shows the changes in the T.V.F.A. in control and all treatments. These data reveal that there was slight difference among all treatments and control in zero time, but, these differences were high among the control and all treatments. The content of T.V.F.A. decreased with the increasing of cannellini beans powder, So, at the end of storage the treatment 4 contained the lowest content of T.V.F.A(53%) among other treatments or control yoghurt. These results might be due to the inhibitory effect of cannellini beans powder on the viability and the ability of starter microflora to

fat hydrolysis. But, this effect was very low on the low ratios of cannellini beans powder. These findings disagreement with Rabie (1979).

Table (1):Changes in chemical composition (%) of yogurt fortified with different levels of skim milk and Cannelline beans powder .

Item	Treatment	Storage periods		
		Zero time	7 days	14 days
pH	Control	4.33	4.27	4.67
	T1	4.40	4.30	4.61
	T2	4.47	4.33	4.58
	T3	4.49	4.44	4.53
	T4	4.50	4.46	3.17
Acidity	Control	1.88	1.93	2.15
	T1	1.87	1.84	2.11
	T2	1.73	1.81	1.61
	T3	1.25	1.65	1.56
	T4	1.20	1.45	1.35
Fat /Dray matter	Control	30.4	30.5	30.2
	T1	29.5	28.3	29.4
	T2	28.9	34.3	31.8
	T3	28.4	31.9	29.3
	T4	28.2	34.1	33.5
T. V. F. A %	Control	44	72	80
	T1	44	68	95
	T2	43	52	69
	T3	41	50	68
	T4	39	46	53
T. p %	Control	3.8	3.85	3.88
	T1	3.77	3.81	3.82
	T2	3.75	3.8	3.82
	T3	3.7	3.76	3.80
	T4	3.6	3.71	3.73
S. P%	Control	0.067(0.42)	0.074 (0.47)	0.088 (0.56)
	T1	0.074(0.47)	0.081 (0.51)	0.095 (0.60)
	T2	0.074(0.47)	0.081 (0.51)	0.096 (0.61)
	T3	0.081(0.51)	0.089 (0.56)	0.098 (0.62)
	T4	0.088(0.56)	0.095 (0.60)	0.102 (0.65)
S. P / T.P	Control	11.00	12.20	14.43
	T1	12.46	13.38	15.70
	T2	12.53	13.42	15.96
	T3	13.78	14.89	16.31
	T4	15.55	16,17	17.42
N. P. N%	Control	0.0196	0.0200	0.0202
	T1	0.0210	0.0214	0.0215
	T2	0.0224	0.0229	0.0230
	T3	0.0231	0.0237	0.0238
	T4	0.0238	0.0240	0.0242

Control: cow milk+2% skim milk
T1: cow milk+1.5% skim milk +0.5% Cannellini beans powder
T2: cow milk+1% skim milk +1% Cannellini beans powder
T3: cow milk+0.5% skim milk +1.5 % Cannellini beans powder
T4: cow milk+2% Cannellini beans powder

Data in Table (1) show the differences in total protein and the ratio between soluble protein (S.P) and total protein of control yoghurt and other

treatment. These data reveals that the total protein content decreased with the increase of cannellini beans powder, and this might be due to the decrease of the protein in this powder, when compared with the protein content in the skim milk powder. In addition, with the progress in the storage period the protein content increased as a relation with the increase in the total solids, in general. The same data indicate the developing in the soluble protein content and reveal that the amount of soluble protein increased with the increase of cannellini beans power. This was affected in the ratio of S.p / T.P ,which increased with the increase in the cannellini bean powder ratio.

Microbiological properties:

Data in Table (2) indicate the microbiological quality of control and other treatments.

Table (2): Changes in Microbiological properties of yogurt fortified with different levels of skim milk and Cannelline beans powder .

ITEM	TREATMENT	STORAGE PERIODS		
		Zero time	7 days	14 days
Total bacterial counts	Control	44	63	62
	T1	42	57	53
	T2	34	44	37
	T3	19	37	28
	T4	16	29	15
Moulds& yeasts	Control	ND	ND	3
	T1	ND	ND	8
	T2	ND	ND	12
	T3	ND	ND	ND
	T4	ND	ND	ND
E.coli & staph. Sp.	Control	ND	ND	ND
	T1	ND	ND	ND
	T2	ND	ND	ND
	T3	ND	ND	ND
	T4	ND	ND	ND

Control: cow milk+2% skim milk
T1: cow milk+1.5% skim milk +0.5% Cannellini beans powder
T2: cow milk+1% skim milk +1% Cannellini beans powder
T3: cow milk+0.5% skim milk +1.5 % Cannellini beans powder
T4: cow milk+2% Cannellini beans powder

These data reveal that there were gradual decrease in the numbers of lactic acid bacteria with the increase of cannellini beans powder ratio. Moreover, these counts decreased with the progress in storage periods in all treatments and control yoghurt. This decrease was more pronounced in all treatments when compared with the control yoghurt. These results are in agreement with the findings of Masud *et al* (1991). In addition, the decrease rate was increasing with the increase of cannellini beans powder. These results might be due to the presence of inhibitory factors in cannellini beans powder on the microorganisms .Also, these data indicate that there was a late growth of the moulds and yeasts in control and the two first treatments. Moreover, the presence of moulds and yeasts appears gradually among these treatments and control, so, treatment (T2) contained the highest counts(12) of moulds and yeasts ,when compared with other treatment and

control yoghurt. reduction in potential oxygen during fermentation process may provide suitable conditions for the growth of yeasts and moulds. Yeasts are commonly associated with traditional fermented dairy products, and have been reported earlier (Beukes *et al* 2001; Isono *et al* 2001). Contamination by yeasts and moulds in traditionally processed yogurt was reported by Dardashti *et al* (2001). Other treatments (T3 and T4) were fully free from any presence of moulds and yeasts .These results might be also due the inhibitory effect of cannellini beans powder. All treatments and control yoghurt were completely free from any growth on macconkey agar media These results are in disagreement with the findings of El-Kosi *et al* 2000; Quinto *et al* 2000 (*Escherichia coli* was observed to survive the low pH of domestic yogurt developed during cold storage and could tolerate lower acidity up to 6 days)**.** and staph. 110 media at zero time and until the end of storage period.

Table (3): Changes in Organoliptic properties of yogurt fortified with different levels of skim milk and Cannelline beans powder .

Item	Treatment	Storage Periods		
		Zero time	7 days	14 days
Appearance	**Control**	7	7.6	7.2
	T1	6.2	6.2	6
	T2	7.4	6.2	5
	T3	8.6	6.7	6.2
	T4	8.2	6.5	6.0
Flavour	**Control**	34	40.6	34.2
	T1	36.8	41.8	35.4
	T2	36.4	41	38.8
	T3	36.2	42.6	34.8
	T4	32.6	40.8	27
Body &texture	**Control**	31.2	31	27
	T1	31.0	26.2	22.8
	T2	31.2	27.2	21.6
	T3	32.2	31	29.6
	T4	30.8	24.6	27
Total score	**Control**	72.2	79.2	68.4
	T1	74	74.2	64.2
	T2	75	74.4	64.4
	T3	77	80.3	70.6
	T4	71.6	71.9	60

Control: cow milk+2% skim milk
T1: cow milk+1.5% skim milk +0.5% Cannellini beans powder
T2: cow milk+1% skim milk +1% Cannellini beans powder
T3: cow milk+0.5% skim milk +1.5 % Cannellini beans powder
T4: cow milk+2% Cannellini beans powder

Data in Table (3) shows the changes in sensory evaluation of control yoghurt and other treatments .These data indicate that all treatments except (T4) which contains 2 % cannellini bean powder gained similar scores to those in control yoghurt as regards with flavor and body and texture evaluations, In addition T4 gained the highest score in appearance compared with all treatments and control yoghurt. These results on flavor might be due to the clarity of beany flavor of cannellini bean powder when it was in high concentration. The high ratio of cannellini bean powder caused an

enhancement in appearance because it is of more whiteness than skim milk powder. Moreover, the low scores in body and texture being appeared in T4 might be due to the decrease in the casein ratio of this treatment when compared with other treatments and control yoghurt. In addition, all sensory evaluation scores were enhanced during the storage period until 7 days, followed by a decrease until the end of storage period. moreover, this decrease was more propound in T4, when compared with other treatments and control yoghurt. The enhancement in these scores until 7 days might be due to the explicitness the acidity of all treatment and control yoghurt .This explicitness was less in T4 than other treatments and control yoghurt, and this was caused by the weak acid production on T4 which contains the more ratio of cannellini bean powder of the inhibitory effect on yoghurt starter microorganisms. These results are in agreement with (Duboc and Mollet 2001; Vargas *et al* 2008). In general, all treatments and control yoghurt had evaluation score above 50 % from the total score and this means that all treatments had an acceptability to the judgment persons, but , T4 was of the lowest acceptability either when it was fresh or stored. These results might be due to the beany-off flavour and more pasty body at the end of storage period. Generally, Microbial hydrolysis of yogurt component during storage was found to be the key deteriorating factor to taste, color, flavor, and texture (El-Gazzar and Hafez 1992), which hence affect the overall preference of the product.

Table (4): Changes in Curd syneresis of yogurt fortified with different levels of skim milk and Cannelline beans powder .

Storage period	Treatments	Time/ minute		
		20	60	120
Zero time	Control	5.53	6.33	6.71
	T1	4.48	5.02	6.1
	T2	5.04	5.46	5.67
	T3	5.10	5.61	5.69
	T4	4.03	4.71	5.07
1 week	Control	2.7	4.00	4.4
	T1	3.24	4.51	5.15
	T2	3.01	4.17	4.6
	T3	2.61	3.80	4.01
	T4	0.81	2.07	2.35
2 weeks	Control	1.44	1.8	2.5
	T1	1.22	1.6	2.2
	T2	2.21	2.8	3.44
	T3	2.1	2.64	3.32
	T4	0.0	0.03	0.17

Control: cow milk+2% skim milk
T1: cow milk+1.5% skim milk +0.5% Cannellini beans powder
T2: cow milk+1% skim milk +1% Cannellini beans powder
T3: cow milk+0.5% skim milk +1.5 % Cannellini beans powder
T4: cow milk+2% Cannellini beans powder

Data in Table (4) shows the differences in the curd syneresis of control yoghurt and other treatments when it were fresh and during storage. These data indicate that there were a decrease in the amount of the syneresis as a correlation with the progress in the storage period, where, all

treatments contained high whey amounts at the first period of storage, followed by a decrease in all treatments and control during storage until the end of storage period. Moreover, treatment 1(T1) was near from the control yoghurt in all storage periods.On the other hand, T4 was the lowest whey amounts when it was fresh or stored product, Moreover, this treatment was converted to pasty body and no whey dropped out at the end of storage period. These results are in disagreement with Galal *et al*. (2003). In general, the amount of whey or curd syneresis values decreased with the increase of cannellini bean powder ratio.

Table (5): Changes in Curd tension of yogurt fortified with different levels ofskim milk and Cannelline beans powder .

Treatment	The weight needed for raising the knife/gm/storage period		
	Zero time	1 week	2 weeks
Control	36.8	40.71	41.3
T1	22.8	23.8	25.2
T2	21.9	29.3	31.1
T3	20.7	28.83	33.00
T4	19.8	34.94	35.1

Control: cow milk+2% skim milk
T1: cow milk+1.5% skim milk +0.5% Cannellini beans powder
T2: cow milk+1% skim milk +1% Cannellini beans powder
T3: cow milk+0.5% skim milk +1.5 % Cannellini beans powder
T4: cow milk+2% Cannellini beans powder

Data in Table (5) shows the changes in the curd tension values of control and other treatments. These data indicate that there was a decrease in the curd tension values with the increase of cannellini bean powder ratio. The treatment 4 (T4) had the lowest curd tension(19.8 values), when it compared with other treatments and control yoghurt. These results might be a result of the decrease in casein content, which was important to confirm the casein micelles and casein net, which makes the opposing action. On the other hand, the curd tension values increased in all treatments and control yoghurt with the progress in the storage period, moreover, treatment 4 (T4) gained the highest value of curd tension among other treatments and was near from the control yoghurt. These results might be due to the absorption of free water by the fiber content of cannellini bean powder ,which confirms the body of yoghurt to the pasty-like body which increase the opposing action on all treatment and this effect increased with the increasing of cannellini bean powder. Nearly similar finding was reported by Galal *et al*. (2003).

CONCLUSION

The results of the present investigation are of practical value. The use of Cannelline beans with yoghurt was advantageous due to inhibitory effect on *staphylococcus spp*, coliform , moulds and yeasts**.** In addition Cannelline beans is safe for public health. The results highlighted the possibility of T3 . The developed treatment was evaluated and proved to be of good quality, long shelf life and could be kept at 4˚C for 14 days without significant microbial growth or loss of the product color & texture during manufacture and storage.

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جودة وصلاحية الزبادي المدعم بمسحوق الفاصوليا البيضاء

محمد الدسوقى عبد العزيز و متولى محمد ابوسريع
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استعمل مسحوق الفاصوليا البيضاء في صناعة الزبادي المصنع من لبن بقري و المدعم بـ ٢ % لبن لبن فرز حيث تم استبدال اللبن الفرز المجفف بمسحوق الفاصوليا البيضاء بنسب استبدال (٢٥ و٥٠ و٧٥ و ١٠٠ %) من نسبة اللبن الفرز المجفف المضاف لرفع القيمة الغذائية للمنتج حيث تم تصنيع جميع المعاملات وعينة المقارنة باستخدام الباديء التقليدي واتبعت نفس الخطوات التقليدية في الصناعة. حفظت جميع المعاملات وعينة المقارنة تحت ظروف التبريد وتم تقيم جميع المعاملات وعينة المقارنة كيماويا وميكروبيولوجيا وحسيا وريولوجياً. اظهرت النتائج تفوق المعاملة المحتوية علي ٧٥ % استبدال للبن الفرز المجفف بمسحوق الفاصوليا البيضاء تفوقا علي باقي المعاملات وحققت قيما قريبة من الموجودة في عينة المقارنة وكذلك كان لمسحوق الفاصوليا تأثيرا مثبطا علي ميكروبات القولون وميكروب التسمم الغذائي وكذلك الفطريات والخمائر. وبوجه عام اظهرت النتائج امكانية استخدام مسحوق الفاصوليا البيضاء كبديل جيد للبن الفرز المجفف في تصنيع الزبادي.

قام بتحكيم البحث

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