J. of Food and Dairy Sci., Mansoura Univ., Vol. 14 (3):73 - 79, 2023

Journal of Food and Dairy Sciences

Journal homepage & Available online at: www.jfds.journals.ekb.eg

Quality and Chemo-Physical Properties of Yoghurt Supplemented with Soybean and Skim Milk Powders

Seham, Swelam.[1*]; N. M. Mehanna[1]; W. M. Farag alla[1]; Susu M. Alasfoury[2] and A. M. Abd El-Aziz[1]

Cross Mark

[1] Dairy Science Department, Faculty of Agriculture, Kafrelsheikh University, Egypt.
[2] Agricultural Research Center, Food Technology Research Institute (FTRI), Egypt- Taif University, P.O. Box 11099, Taif 21944, Saudi Arabia.

ABSTRACT

This study examined the effect of supplementing yoghurt milk with soybean powder (SBP) and skim milk powder (SMP) with different concentrations on the resulting yoghurt's chemo-physical, microbiological, and sensory qualities. Based on the observed results, it can be stated that the fermentation duration increased proportionally with rising SBP content. Adding different concentrations of SBP and SMP raised TS and protein content significantly ($P \leq 0.05$). Adding SBP at a concentration of 3% with 1% SMP (T1) resulted in the highest fat content while the lowest pH value was recorded by T3 (1% SBP and 3% SMP). Adding SBP and SMP at varying doses caused Zn, Fe, and K concentrations to rise considerably. Adding 4%, SMP greatly boosted P and Ca. Adding a mixture of SBP and SMP much reduced wheying off, with the lowest values obtained by adding 4% SMP (T4) and 1% SBP and 3% SMP (T3). The exact opposite trend was observed for curd tension. The microbiological research revealed that adding various amounts of SMP and SBP considerably lowered the total bacterial counts (TBC) compared to the control. By combining 3% SBP with 1% SMP, anaerobic bacteria were drastically reduced. In contrast, aerobic bacteria increased significantly in all treated samples relative to the untreated sample. The number of points awarded for general appearance and smoothness grew as the amount of SMP rose. There were no obvious differences ($P>0.05$) in the flavour rankings between the treated and untreated yoghurt; all samples were free of off-flavours.

Keywords: Yoghurt, fermentation time, minerals content.

INTRODUCTION

Yoghurt is a rich source of numerous nutritional components. Since it is derived from milk, it contains protein, necessary amino acids, an abundance of bioavailable minerals (calcium, phosphorus, magnesium, iron, and zinc), and bioavailable vitamins (riboflavin, folate, and niacin) (Buttriss, 1997; Marona and Pedrigon, 2004; McKinley, 2005; Shah, 2006). Some vitamins, such as folic acid, are present in greater quantities in yoghurt compared to milk since it is produced by the bacterial culture. Regarding specific nutrients, consuming 150 g of yoghurt would give 41% of a 5-year-daily old's calcium needs and roughly 25% of an adult or adolescent girl's calcium needs (McKinley, 2005).

Besides its nutritional content, yoghurt has other health benefits. According to a prior study, yoghurt eating is associated with a decrease in lactose intolerance compared to milk consumption. (de Vrese *et al*., 2001; Salminen *et al*., 2004; McKinley, 2005). It has been reported that yoghurt possesses anti-carcinogenic properties, and since then several studies have demonstrated that yoghurt eating inhibits numerous cancers such as breast and exocrine pancreatic cancer (Shah, 2006; Sarkar, 2008). *S. thermophilus* was less effective than *L. bulgaricus* at inhibiting tumour growth. Certain strains of *L. bulgaricus* and *S. thermophilus* lower cholesterol levels (Dilmi-Bouras, 2006). In general, yoghurt production and consumption continue to increase due to its medicinal benefits and high nutritional content (Karagul *et al*., 2004; He *et al*., 2005).

On the other hand, soybeans are one of the Far East's most widespread and oldest crops. Large portions of the world often consume it as a source of protein and oil. Soybeans are a major source of plant-based protein; thus, it is the highest protein content (around 40%) and the second largest oil content (20%) of all legumes. So, it is produced in the greatest quantity per unit of land. Due to the inefficiency and expense of isolating the protein from soybeans, soy products such as soymilk should be utilized more directly (Liu, 2012). It is crucial to note that soybean is considered a premium source of protein which simply digested, and its content of amino acids matches the essential for human nutrition while it is slightly deficient in amino acids containing sulfur (methionine) (Belleville, 2002).). Soy milk can be regarded as functional milk since it has additional bioactive compounds that may improve health or reduce illness risk. Soybean is rich in phenolic compounds with antioxidant characteristics and isoflavones, a category of phytoestrogens that may reduce age-related and hormonal disorder risk (Jiang *et al*., 2013). In addition, soybeans provide some protective effects against osteoporosis, cardiovascular disease, and cancer cells in particular prostate, breast, colon, rectum, and stomach (Storm *et al*., 2001). Compared to fermented milk products, fermented soymilk products may have more economical and nutritional value due to their higher protein content and and

[*] **Corresponding author.**
E-mail address: seham.abdelhameed@agr.kfs.edu.eg
DOI:10.21608/jfds.2023.195858.1100

comparatively lower prices (Sun and Young, 2008). Soy yoghurt is growing in popularity because it is free of lactose and has low levels of cholesterol and saturated fat (Drake and Gerard, 2003). Cavallini *et al*., (2009) added that the consumption of soybean yoghurt may decrease the risk of cardiovascular diseases by enhancing lipid profiles and preventing the production of oxidized low-density lipoprotein autoantibodies. In contrast, yoghurt made from imitation milk extracted from soybeans and milk extracted from other plant sources were plagued with numerous issues. The beany flavour is the most frequent flaw created by using soybeans (Bristone *et al*., 2015). Fermentation is recognized to improve the appearance, aroma, and flavour of soy products, and it also has the potential to increase their acceptability. (Favaro *et al*., 2001). If the acidity of fermented soy milk is raised, it is anticipated that flavour acceptance will be enhanced further compared to fermented cow's milk. For this reason, soymilk has been enriched with skimmed milk as a source of lactose as a substance for fermentation, in an effort to improve soy yoghurt (Buono *et al*. 2006).

Consequently, the purpose of this study was to combine the nutritional and health benefits of yoghurt with SBP in a single fermented dairy product (yoghurt) while employing SMP to prevent or eliminate the sensory and physical abnormalities that SBP may produce.

MATERIALS AND METHODS

Materials:

The used cow's milk (3.9% fat, 3.12% protein and 0.7 ash) was got from a private farm in Desouk, Kafr El-Sheikh, Egypt. Skimmed milk powder (spray dried - low heat) was obtained from Green Fields Company, Kafr El-Sheikh, Egypt. It contains 4% moisture, 36 % protein, 1.25% fat, 52. 5% lactose and 8 % ash. Soybean powder (SBP) was obtained from Silver Star for Food Industry Company, containing 4% moisture, 35% protein, 7% fat, and 8% ash. *Streptococcus thermophilus* and *Lactobacillus dellbreuckii* subsp. *bulgaricus* (1:1) are used as a DVS yoghurt starter culture (YC-X11) which was purchased from CHR - Hansen's lab in Denmark.

Yoghurt making:

The method of Tamime and Robinson (1999) was used in the manufacture of yoghurt, including heating milk at 90ºC for 20 min., cooling it to 40ºC, inoculating it with DVS yoghurt starter culture (0.02%) and incubating at 40ºC to complete coagulation followed by cooling overnight in the refrigerator at 5±1°C. Before the heat treatment, the yoghurt milk was separated into five equal pieces. Part(1) served as the control, while the remaining four parts were supplemented with SBP and SMP to create T1 (milk with 3% SBP and 1% SMP), T2 (milk with 2% SBP and 2% SMP), T3 (milk with 1% SBP and 3% SMP), and T4 (cow's milk with 4% SMP).

Methods of analysis

The activity of yoghurt culture:

It is measured by following the decrease of the pH values at different intervals during milk fermentation until the pH reached about 4.6 (Swelam, 2018).

Chemo-physical analysis of yoghurt:

The TS, Fat and protein content were measured according to the method given by AOAC (2007). A lab pH metre with a glass electrode was used to electrometrically measure the pH value (Crison pH meter, Spain). Titratable acidity was measured as lactic acid as given by Caric *et al.* (2000). The method given by AOAC, (2000) was used to assess the mineral content, thus a set weight of ashed samples was dissolved in a solution of hydrochloric acid 20N and 2N, which was then measured using an atomic absorption spectrophotometer (BB model Avanta Σ mar GBC, Australia). The curd tension was estimated as the method of Abd EI-Salam *et al*. (1991). The procedure mentioned by Lucey *et al.* (1998) was used to determine the Wheying-off.

Microbiological analysis of yoghurt:

Following the procedures in the Difco manual (1998), total bacterial counts (TBC) were counted using Tryptone Glucose Extract Agar Medium. Aerobic and anaerobic spore-forming bacteria were counted according to the method given by Burgess *et al.* (2010) using a nutrient agar medium under certain conditions.

Sensory evaluation of yoghurt:

The sensory attributes of yoghurt were assessed by 15 professionals from the Faculty of Agriculture, Kafrelsheikh University, using the methodology outlined by Swelam *et al.* (2019).

Statistical analysis of yoghurt:

SPSS version 10.0 was used for the statistical analysis. Analysis of variance and Duncan's test were used to obtain any significant variations between averages at the significance level of 0.05. Three replicates of the data were used to calculate the mean and standard error (SE) (SPSS, 2016).

RESULTS AND DISCUSSION

The activity of yoghurt culture:

The required time to attain pH 4.6 was utilized to evaluate the activity of the used culture. The addition of SBP to yoghurt milk increased ($P \leq 0.05$) the time needed to a pH of 4.6, and this increase was proportional to the SBP content. As demonstrated in Fig. (1), the addition of SBP and SMP did not affect pH at the start of incubation. A negligible effect was observed at 30, 60, and 90 minutes. After 90 minutes of incubation, the data were significantly different. Since the longest period was observed by introducing SBP at a concentration of 3%. On the pH development, no significant variations were noticed between the control, T3 (1% SBP and 3% SMP), and T4 (4% SMP). For soy-based yoghurt, Pinthong *et al*. (1980) and Ismail *et al*. (2016) found longer fermentation times or lower final titration acidities, presumably as a result of the SBP addition to the used milk depriving the lactic acid bacteria of vital nutrients (Karleskind *et al.* 1991; Chumchuere and Robinson 1999).

Chemical composition of yoghurt:

Table (1) demonstrates that the TS content in the control yoghurt was significantly lower than in the other treatments. On the other hand, the variations between the treated samples were minor ($P \leq 0.05$). This could be attributable to the almost identical TS content of the supplementation materials (SBP and SMP). T1 (cow's milk with 3 % SBP and 1% SMP) had significantly higher fat content than the control and other samples. Negligible variations ($P > 0.05$) in fat content between the control and other treatment samples were found. According to Table (1), the protein content of yoghurts was considerably greater in all treatments than in the control. There were insignificant changes between various treatments. As anticipated, the resulting yoghurt's protein content rose with increasing SBP or SMP. Treatment 3 (cow's milk with 1% SBP and 3% SMP) significantly lowered pH compared to the control and other treatments. However, the acidity readings followed the opposite pattern as pH. The changes in the chemical composition of the treated yoghurt samples compared to the control may be related to the chemical composition of the additives of SBP and SMP. Our results are reinforced by Krupal (2003), who found that adding soymilk increased the protein content of yoghurt. El-Sheikh (2001) revealed that adding SMP by the concentrations of 2, 3, and 4% to cow's milk increased the acidity of the resulting fresh yoghurt from 0.68 to 0.70 and 0.73% respectively and dropped the pH values from 4.76 to 4.73 and 4.76 in order. Olubamiwa *et al.* (2008) reported that adding 5g of SMP to soya milk increased the acidity of the resulting yoghurt, while the pH was much lower than the control (soya yoghurt without SMP). explained that SMP offers lactose as a substrate for the used culture while the low levels of lactose in soy milk result in a relatively high pH value and low acidity in yoghurt (Lee *et al.*, 1990; Yang and Lee, 2010). In addition, Ponka *et al.* (2022) confirmed that yoghurt manufactured from cow's milk alone has a higher titratable acidity than yoghurt prepared from soy milk..

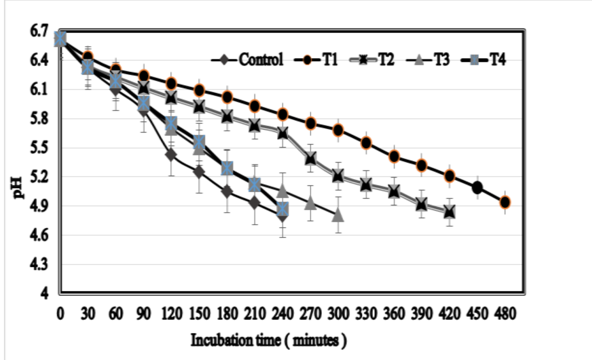

Fig. 1. pH development during yogurt preparation supplemented with soybean powder (SBP) and skim milk powder (SMP).

- Control: cow's milk only; T1: cow's milk contained 3 % SBP and 1 % SMP; T2: cow's milk contained 2 % SBP and 2% SMP; T3: cow's milk contained 1 % SBP and 3 % SMP; T4: cow's milk contained 4 % SMP.

Table 1. Chemical composition and some properties of yoghurt supplemented with soybean powder (SBP) and skim milk powder (SMP).

Treatments*	TS (%)	Fat (%)	Protein (%)	pH	Acidity (%)
Control	12.5 ± 0.28^{b}	3.90 ± 0.35^{b}	3.12 ± 0.12^{b}	4.76 ± 0.01^{ab}	0.75 ± 0.01^{b}
T 1	16.57 ± 0.34^{a}	4.47 ± 0.31^{a}	4.38 ± 0.13^{a}	4.87 ± 0.04^{a}	0.71 ± 0.03^{b}
T 2	16.53 ± 0.29^{a}	4.27 ± 0.31^{b}	4.43 ± 0.12^{a}	4.85 ± 0.03^{a}	0.71 ± 0.03^{b}
T 3	16.57 ± 0.29^{a}	4.07 ± 0.31^{b}	4.35 ± 0.10^{a}	4.68 ± 0.03^{b}	0.84 ± 0.04^{a}
T 4	16.70 ± 0.29^{a}	3.92 ± 0.37^{b}	4.40 ± 0.10^{a}	4.77 ± 0.04^{ab}	0.75 ± 0.02^{b}

- *Control: cow's milk only; T1: cow's milk contained 3 % SBP and 1 % SMP; T2: cow's milk contained 2 % SBP and 2% SMP; T3: cow's milk contained 1 % SBP and 3 % SMP; T4: cow's milk contained 4 % SMP.

- Average with varied superscript letters differed significantly ($P \leq 0.05$).

Minerals content of yoghurt:

Table (2) displays the mineral composition of yoghurt supplemented with protein. The addition of SMP and SBP led to a significant increase in mineral content. The addition of 4% SMP (T4) resulted in the highest phosphorus (P) level, while T1 (cow's milk supplemented with 3% SBP and 1% SMP) produced the lowest P content. The addition of SBP and SMP at varying concentrations raised Zn, Fe, and K considerably. Since T1 had the highest concentrations of the three minerals, The yoghurt made from milk supplemented with 4% SMP had the greatest Ca content (121.01 mg/100 g), followed by T3 (98.05 mg/100 g). There were no significant changes between the control, T1, and T2 samples in Ca content. The increased level of Zn, Fe, and K minerals in SBP and SMP compared to the cow's milk used to make plain yoghurt may be the reason for the rise in these mineral contents of yoghurt by adding SBP and SMP. Thus according to the finding of Etiosa *et al.*, (2017) the concentrations of minerals (P, Zn, Fe and Ca) in soybean powder were 695.2, 2.7, 16.4, and 300.36 mg/100g respectively. While, the contents of P, Zn, Fe, K and Ca in SMP were 970, 4.0, 0.27, 1590, and 1280 mg/100g in order (Roe *et al.*, 2015). Moreno Rojas *et al*, (1993) reported that the potassium content of plain yoghurt was 184.3 mg / 100 g. Amellal-Chibane and Benamara (2011) estimated the K and Fe contents of yoghurt to be 72.5 and 0.96 mg/100g in order. Buttriss (1997) determined the Zn content be between 0.385 and 0.524 mg/100g, while it was 0.550 and 0.79 mg/100g according to Varo *et al.* (1980) and Amellal-Chibane and Benamara (2011) respectively. The calcium content of yoghurt ranged from 111.2 to 293.8 mg /100g (Rojas *et al.*, 1993; Buttriss, 1997; Garcia Martinez *et al.*, 1998; Amellal-Chibane and Benamara, 2011). In addition, Ponka *et al.*(2022) confirmed that adding SBP to yoghurt milk causes an increase in Fe content and a decrease in Ca content.

Table 2. Minerals content (mg/100g) of yoghurt supplemented with soybean powder (SBP) and skim milk powder (SMP).

Treatments*	P	Zn	Fe	K	Ca
Control	142.00 ± 4.53^{bc}	0.35 ± 0.02^{d}	1.85 ± 0.12^{d}	142.50 ± 2.34^{e}	88.20 ± 2.5^{bc}
T 1	117.27 ± 1.10^{d}	0.61 ± 0.02^{a}	4.20 ± 0.15^{a}	230.12 ± 1.90^{a}	82.64 ± 0.66^{c}
T 2	133.78 ± 4.77^{c}	0.47 ± 0.02^{b}	3.23 ± 0.08^{b}	147.77 ± 0.99^{d}	78.15 ± 5.04^{c}
T 3	149.15 ± 1.02^{b}	0.42 ± 0.01^{bc}	2.63 ± 0.13^{c}	155.90 ± 0.97^{c}	98.05 ± 4.69^{b}
T 4	180.24 ± 3.82^{a}	0.38 ± 0.00^{cd}	2.32 ± 0.11^{c}	179.00 ± 1.25^{b}	121.01 ± 2.7^{a}

- *Control: cow's milk only; T1: cow's milk contained 3 % SBP and 1 % SMP; T2: cow's milk contained 2 % SBP and 2% SMP; T3: cow's milk contained 1 % SBP and 3 % SMP; T4: cow's milk contained 4 % SMP.

- Average with varied superscript letters differed significantly ($P \leq 0.05$).

Physical properties of yoghurt:

Table (3) illustrates the impact of the various supplements on the curd tension (CT) of yoghurt. Especially when SBP was added by 3% with 1% SMP (T1) and SMP was added alone by 4% (T4), a considerable improvement in CT was noted. The control sample had the lowest CT (25.11 g), followed by T2 (29.33 g). Wheying off expressed as a per cent of whey is shown in Table (3). It is obvious that a sharp decrease in the wheying off was observed in T4 (0.56%) followed by T1 (0.89%) and then T3 (2.67%). No statistically significant differences existed between T2 (4.00%) and the control sample (4.44%). This tendency could be related to an increase in TS content. The greater the levels of TS and CT, the lesser the quantities of whey secreted from the curd (El-Asfory, 1999). In this regard, Zanhi and Jideani (2012) observed that yoghurt supplemented with non-fat dried milk (NFDM) had a greater water-holding capacity than yoghurts fortified with soya milk powder (SYMP). They also found that wheying off the yoghurts dropped as the combination of SYMP and NFDM increased. This may indicate that the free water molecules in the yoghurt matrix were absorbed more efficiently as the level of fortification increased (Cais-Sokolinska *et al*., 2002). According to Mansour *et al*. (1994), and Sakr (2004), the rise in CT owing to TS content may be attributable to the functional qualities of the additional protein.

Table 3. Curd tension (CT, g) and wheying off (%) of yoghurt supplemented with soybean powder (SBP) and skim milk powder (SMP).

Properties	Control	T 1	T 2	T 3	T 4
Curd tenstion	25.11 ± 0.2^{d}	42.80 ± 0.2^{a}	29.33 ± 0.37^{c}	34.11 ± 0.30^{b}	42.00 ±0.16^{a}
Wheying off	4.44 ± 0.4^{a}	0.89 ± 0.20^{c}	4.00 ± 0.29^{a}	2.67 ± 0.16 ^{b}	0.56± 0.26 ^{c}

- Control: cow's milk only; T1: cow's milk contained 3 % SBP and 1 % SMP; T2: cow's milk contained 2 % SBP and 2% SMP; T3: cow's milk contained 1 % SBP and 3 % SMP; T4: cow's milk contained 4 % SMP.
- Average with varied superscript letters differed significantly (P ≤ 0.05).

Microbiological analysis of yoghurt:

Fig. (2) depicts the total bacterial count (TBC) in yoghurt samples. TBC fell significantly due to the various treatments. The sample was made from cow's milk and supplemented with 3% SBP and 1% SMP (T1) had the lowest TBC (8.65 log CFU/g), while the control sample had the highest TBC (9.25 log CFU/g). The current results concur with those previously given by Ismail *et al* (2016) who stated that the lactic acid bacteria decreased significantly in soya yoghurt compared to cow's yoghurt. These results indicate that soy milk has a detrimental effect on *L. bulgaricus*. According to Sumarna (2008), *S. thermopilus*, 001 grew more favourably and produced more organic acid during the fermentation of soy milk than *L. delbrueckii* subsp. *bulgaricus* FNCC, 0045. This can be explained by the finding demonstrated by Mital *et al.* in 1974 that *S. thermophilus* can grow significantly and produce significant acid levels in soymilk due to its ability to use sucrose in fermentation. In the contrast, *L. delbrueckii ssp. bulgaricus* did not grow well in soymilk due to its incapacity to ferment sucrose and other soymilk carbohydrates.

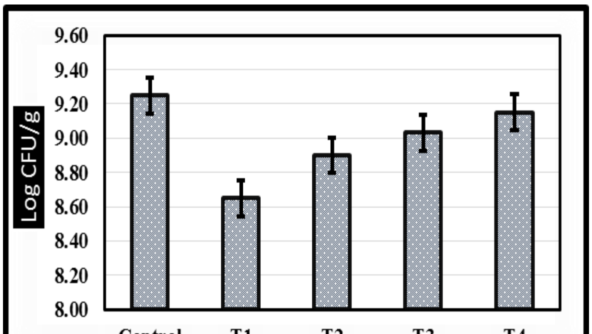

Fig. 2. Total bacterial count (log CFU/g) of yoghurt supplemented with soybean powder (SBP) and skim milk powder (SMP).
- Control: cow's milk only; T1: cow's milk contained 3 % SBP and 1 % SMP; T2: cow's milk contained 2 % SBP and 2% SMP; T3: cow's milk contained 1 % SBP and 3 % SMP; T4: cow's milk contained 4 % SMP.

Fig. (3) demonstrates that the control sample was free of anaerobic bacterial spores. Different treatments resulted in the emergence of anaerobic bacterial spores. T1 and T4 had the highest numbers, with minor differences (P>0.05) between them. T2 had the lowest value detected compared to other treatments. Results in Fig. (4) showed that aerobic spore forms bacteria counts increased significantly by applying different treatments. Since the highest counts were noticed for T4 (4% SMP). The thermophilic spore-forming bacteria, such as *Geobacillus spp*., which are prevalent contaminants in milk powder factories, may be responsible for the high counts of spore-forming bacteria in T4, which included 4% SMP. Their spores can survive the full industrial manufacturing process for dairy powder, including pasteurization (72 °C/15 sec.) and the much hotter evaporator stages, while it is not harmful to human health. (Tuflikha, 2017). According to Fang *et al.* (2018), *B. licheniform* is a facultative anaerobe bacteria found in skim milk powder that can live at both mesophilic as well as thermophilic temperatures, making it more challenging to manage in dairy processes.

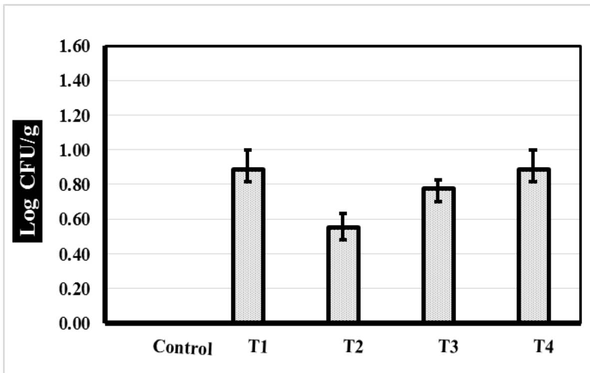

Fig. 3. Anaerobic bacterial spores "CFU /g" of yoghurt supplemented with soybean powder (SBP) and skim milk powder (SMP).
- Control: cow's milk only; T1: cow's milk contained 3 % SBP and 1 % SMP; T2: cow's milk contained 2 % SBP and 2% SMP; T3: cow's milk contained 1 % SBP and 3 % SMP; T4: cow's milk contained 4 % SMP.

Sensory evaluation of yoghurt:

There were no significant variations in general appearance between the control and the other treatments, as shown in Table (4). However, T1 was considerably lower than T3 and T4. The same pattern was found for smoothness, which recorded its lowest value at T1 (8.11). The control sample had the lowest score for firmness (7.44), while yoghurt manufactured from cow's milk containing 3% SBP with 1% SMP had the highest value (9.44). Table (4) demonstrates that adding SBP and SMP improved the wheying off property. T1 (9.22) and T4 (9.67) had the highest scores, with no significant differences between them, followed by T3 (8.89). The flavour attributes did not change due to the applied treatments, moreover, no unfavourable flavours were detected for all the resultant yoghurts. These findings are consistent with this of Yadav *et al.* (2003), who observed a declining trend in the appearance attribute of yoghurt as the proportion of soymilk increased. Similarly, Ponka *et al*. (2022) reported that increasing the proportion of soy milk diminished all sensory characteristics of the resulting yoghurt. Darke and Gerard (2003) reported that, although soy-fortified yoghurt (2.5%) was not as well-liked as conventional yoghurt, the acceptance scores were higher than 5 (neither like nor dislike). However, adding little amounts of soy protein to yoghurt may be a strategy to include soy protein in the diet. In addition, (Favaro *et al*., 2001) discovered that fermenting decreased the soybean's beany flavour and enhance the acceptability of soya yoghurt. Whether fermentation-derived flavours merely obscured the bean flavour. Olubamiwa *et al*. (2008) observed that adding 5g of non-fat dry milk considerably improved the sensory rating of soya yoghurt (NFDM). Similarly, Zanhi and Jideani (2012) concluded that the sensory characteristics of yoghurt enriched with soya milk powder were greatly enhanced by utilizing the same proportion of non-fat dried milk.

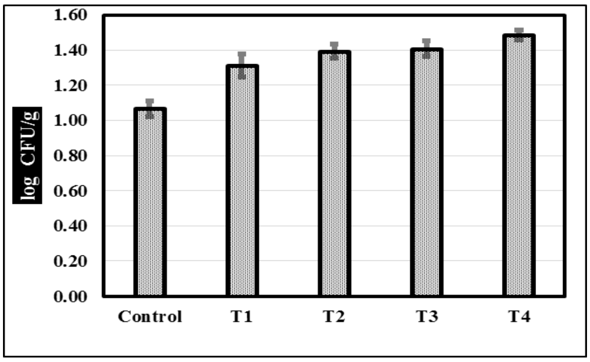

Fig. 4. Aerobic bacterial spores "CFU/g" of yoghurt supplemented with soybean powder (SBP) and skim milk powder (SMP).

- Control: cow's milk only; T1: cow's milk contained 3 % SBP and 1 % SMP; T2: cow's milk contained 2 % SBP and 2% SMP; T3: cow's milk contained 1 % SBP and 3 % SMP; T4: cow's milk contained 4 % SMP.

Table 4. Sensory evaluation of yoghurt supplemented with soybean powder (SBP) and skim milk powder (SMP).

Property	**Treatments***				
	Control	**T1**	**T2**	**T3**	**T4**
General appearance (10)	8.44 ± 0.41^{ab}	8.11 ± 0.30^{b}	8.44 ± 0.29^{ab}	9.22 ± 0.36^{a}	9.44 ± 0.24^{a}
Firmness (10)	7.44 ± 0.18^{c}	9.44 ± 0.24^{a}	8.22 ± 0.40^{bc}	8.77 ± 0.44^{ab}	9.11 ± 0.30^{ab}
Smoothness (10)	8.67 ± 0.23^{ab}	8.11 ± 0.42^{b}	8.33 ± 0.16^{b}	9.44 ± 0.24^{a}	9.33 ± 0.23^{a}
Wheying off (10)	7.00 ± 0.29^{c}	9.22 ± 0.22^{ab}	7.67 ± 0.23^{c}	8.89 ± 0.30^{b}	9.67 ± 0.17^{a}
Flavour (60)	58.11 ± 1.59^{a}	55.67 ± 3.25^{a}	57.22 ± 2.05^{a}	57.89 ± 1.28^{a}	57.67 ± 1.86^{a}
Acid (10)	8.67 ± 0.40^{a}	7.78 ± 0.57^{a}	8.441 ± 0.37^{a}	8.67 ± 0.5^{a}	8.44 ± 0.44^{a}
Bitterness (10)	10 ± 0.00^{a}	9.33 ± 0.47^{a}	9.78 ± 0.22^{a}	9.78 ± 0.23^{a}	10 ± 0.00^{a}
Flat (10)	9.44 ± 0.55^{a}	9.00 ± 0.66^{a}	9.22 ± 0.57^{a}	9.44 ± 0.55^{a}	9.67 ± 0.33^{a}
Foreign (10)	10 ± 0.00^{a}	9.78 ± 0.22^{a}	9.78 ± 0.22^{a}	10 ± 0.00^{a}	9.78 ± 0.22^{a}
Cooked (10)	10 ± 0.00^{a}	9.78 ± 0.14^{a}	10 ± 0.00^{a}	10 ± 0.00^{a}	9.78 ± 0.14^{a}
Unclean (10)	10 ± 0.00^{a}	10 ± 0.00^{a}	10 ± 0.00^{a}	10 ± 0.00^{a}	10 ± 0.00^{a}

- *Control: cow's milk only; T1: cow's milk contained 3 % SBP and 1 % SMP; T2: cow's milk contained 2 % SBP and 2% SMP; T3: cow's milk contained 1 % SBP and 3 % SMP; T4: cow's milk contained 4 % SMP.

- Average with varied superscript letters differed significantly ($P \leq 0.05$).

CONCLUSION

It can be concluded from this study that adding soybean powder (SBP) by 3% with 1% of skim milk powder (SMP) to cow's milk in the manufacture of yoghurt resulted in a sharp increase in minerals contents (ZN, Fe and K) and improved the physical (wheying off) and sensory properties compared to the control sample (yoghurt made from cow's milk only).

REFERENCES

Abd El-Salam; M.H., El-Shibiny, S.; Mahfouz., M.B; El-Dein, H.F; El Atriby H.M. and Antila, V. (1991). Preparation of whey protein concentrate from salted whey and its use in yogurt. J. Dairy Res., 58: 503-510.

Amellal-Chibane, H. and Benamara, S. (2011). Total contents of major minerals in the nature yoghurt and in the yoghurts with the date powder of three dry varieties. Am. J. Food. Nutr., 1: 74-78

AOAC. (2000). Official Methods of Analysis. 17th Ed., Association of Official Analytical Chemists, Gaithersburg, MD, USA.

AOAC. (2007). Official Methods of Analysis. 18th Ed. Association of Official Analytical Chemists, Maryland, USA.

Belleville, J. (2002). Hypocholestrolemic Effect of Soy Protein. Nutrition., 18: 684-685.

Bristone, C.; Badau, M. H.; Igwebuike, J. U. and Igwegbe. A.O. (2015). Production and evaluation of yogurt from mixtures of cow milk, milk extract from soybean and tiger nut. World J. Dairy Food Sci., 10: 159-169.

Buono, M. A.; Setser, C.; Erickson, L. E. and Fung D. Y. C. (2006) .Soymilk Yoghurt: Sensory Evaluation and Chemical Measurement. J Food Sci., 55: 528-531.

Burgess, S.; Lindsay, D. and Flint, S. H. (2010). Thermophilic bacilli and Their importance indairy processing. Int. J.Food Microbiol., 144: 215–225. doi: 10.1016/ j.ijfoodmicro.2010.09.027

Buttriss, J. (1997). Nutritional properties of fermented milk products, Inter. J. Dairy Technol. 50: 21-27.

Cais-Sokolinska, D.; Piku, l. J. and Dankow, R. (2002). Quality and stability of the natural yoghurt produced from milk condensed with whey protein concentrate. Electronic J. Polish Agric. Univ., 5:1505-1518.

Caric, M.; Milanovic, S. and Vucelja, D. (2000). Standard Methods for Milk and Milk Products Analysis. Novi Sad, Srbija.

Cavallini, M.; Albonetti, C. and Biscarini, F. (2009). Nanopatterning soluble multifunctional materials by unconventional wet lithography. Advanced Materials, 21: 1043- 1053.

Chumchuere, S. and Robinson, R. K. (1999). Selection of starter cultures for the fermentation of soya milk. Food Microbiol., 16: 129-137.

de Vrese, M.; Stegelmann, A.; Richter, B.; Fenselau, S.; Laue, C. and Schrezenmeir, J. (2001). Probiotics—compensation for lactase insufficiency. American J. clini N., 73: 421s-429s.

Difco Manual. (1998). Dehydrated Culture Media and Reagents for Microbiological and Clinical Laboratory Procedures. 11th Ed., Detroit, Michigan, USA.

Dilmi-Bouras, A. (2006). Assimilation (in vitro) of cholesterol by yoghurt bacteria. Annals Agric. Environ. Med., 13: 49-53.

Drake, M. A. and Gerard, P.D. (2003). Consumer attitudes and acceptability of soy-fortified yogurts. J Food Sci., 68: 1118-1122.

El-Asfory, S. M. A. (1999). Some aspects of manufacturing and some properties of low-calorie zabady Manufacture. M.Sc. Thesis, Fac. Agric.Tanta Univ., Kafr El-Sheikh.

El-Sheikh, M. M. (2001). Manufacture of yoghurt with added Serigel LP powder. J. Agric. Sci. Mansoura Univ., 26: 6279-6291.

Etiosa, O. R; Chika, N. B. and Benedicta, A. (2017). Mineral and Proximate Composition of Soya Bean. Asian J. Phys. Chem. Sci., 4: 1-6.

Fang, L.; Karen, H.; Kieran, J.; Francis, B. and John, T. (2019). Occurrence and identification of spore-forming bacteria in skim-milk powders. Inter. dairy J., 97: 176-184.

Favaro, C.; Terzi, S.; Trugo, L.; Delamodesta, R. and Couri, S. (2001). Development and sensory evaluation of soymilk based yoghurt. Archivos Latinoamericanos de Nutrición., 51: 100– 104.

Garcia Martinez, M.; Sanchez Segarra, P. J.; Gordillo Otero, M. J.; Amaro Lopez, M.A. and Moreno-Rojas, R. (1998). Valoracionnutricional de la composicion mineral de yogures enteros aromati-zados. Alimentaria, 297: 73-76.

He, M.; Yang, Y. X.; Han, H.; Men, J. H.; Bain, L. H. and Wang, G. D. (2005). Effects of yoghurt supplementation on the growth of preschool children in Beijing suburbs. Biomed. Environ. Sci., 18:192-197.

Ismail, M. M.; Tabekha, M. M.; Ghoniem, G.A.; EL- Boraey, N. A. and Elashrey, H .F. A. (2016). Chemical composition, microbial properties and sensory evaluation of yoghurt made from admixture of buffalo, cow and soy milk. J. Food and Dairy Sci. Mansoura Univ., 7: 299- 306.

Jiang, S.; Cai, W. and Xu, B. (2013). Food quality improvement of soy milk made from short-time germinated soybeans. Foods, 2:198-212.

Karagul, Y.; Wilson, C. and White, H. (2004). Formulation and processing of yoghurt. J. Dairy Sci., 87: 543-550.

Karlekind, K.; Laye, I.; Halpin, E. and Morr, C.V. (1991). Improving Acid Production in Soy-Based Yogurt by Adding Cheese Whey Proteins and Mineral Salts. J. Food Sci., 56: 999-1001.

Krupal, R. G. (2003). Utilization of soy milk and cow skim milk indifferent combinations for yoghurt preparation. M.Sc. Thesis, Fac. Agric. Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, MS (INDIA).

Lee, S. Y.; Morr, C. V. and Seo, A. (1990). Comparison of milk-based and soymilk-based yoghurt. J. Food Sci., 55: 532-536.

Liu, K. (2012). Soybeans: Chemistry, Technology, and Utilization. Chapman and Hall: New York.

Lucey, J. A.; Munro, P. A. and Singh, H. (1998). Whey separation in acid skim milk gels made with glucono δ lactone: effects of heat treatment and gelation temperature. J. Texture Studies, 29:413-426.

Mansour, A. A.; Khalifa, M. Y. and Hanafy, N. M. (1994). Utilization of some dairy by-products in yoghurt manufacture. Egyptian J. Food Sci., 22: 87-97.

Marona, D. and Pedrigon, G. (2004). Yoghurt feeding inhibits promotion and progression of cancer. Med. Sci. Monit., 10: 96-104.

McKinley, M. C. (2005). The nutrition and health benefits of yoghurt. Inter. J. Dairy Tech., 58: 1-12.

Mital, B. K.; Steinkraus, K. H. and Naylor, H. B. (1974). Growth of lactic acid bacteria in soymilks. J. Food Sci., 39: 1018 – 1022.

Moreno Rojas, R.; Canal Ruiz, C.; Amaro Lopez, M.A. and Zurera Cosano, G. (1993). Contenido mineral del yogur natural, Alimentari,. 239: 81-84.

Olubamiwa, A. O.; Adelodun, B. and Kolapo, A. L. (2008). Evaluation of nutritional composition and acceptability of soy-coconut milk-based yoghurt fermented with different starter cultures. Food, 2: 65-69.

Pinthong, R.; Macrae, R. and Rothwell, J. (1980). The development of a soya-based yoghurt: I. Acid production by lactic acid bacteria. Inter. J. Food Sci. Technol. 15: 647-652.

Ponka, R.; Zhung, P. M.; Zomegni, G.; Tchouape, C. G. and Fokou, E. (2022). Organoleptic and Physicochemical Properties of Soy-Milk Yoghurt Enriched with Moringa Oleifera Root Powder. Glob Chall., 23:6(5):2100097. doi: 10.1002/gch2.202100097. PMID: 35602409; PMCID: PMC9121763.

Roe, M.; Pinchen, H.; Churc, S. and Finglas, P. (2015). McCance and Widdowson's The Composition of Foods Seventh Summary Edition and updated Foods Seventh Summary Edition and updated. British Nutrition Foundation Nutrition Bulletin, 40: 36–39.

Rojas, R. M.; Ruiz, C. C.; López, M. A. and Cosano, G. Z. (1993). Contenido mineral del yogur natural. Alimentari,. 239: 81-84.

Sakr, H. S. (2004). A study on manufacture and qualities of some dairy products containing different fat content. Ph. D. Thesis, Fac. Agric, Tanta Univ., Egypt.

Salminen, S.; Playne, M. and Lee, Y. K. (2004). Successful probiotics Lactobacilli: human studies on probiotic efficacy. In Shortt, C, and O "Brien, J. (Ed), Handbook of Functional Dairy Products, (1st ed) (pp. 13-32) New York, NY: CRC Press.

Sarkar, S. (2008). Effect of probiotics on biotechnological characteristics of yogurt – a review. British Food J., 110: 717-740.

Shah, N. P. (2006). Health Benefits of Yoghurt and Fermented Milks. In Chandan RC (Ed.), Manufacturing Yoghurt and Fermented Milk., (1st Ed) (pp. 327-340) Oxford, UK: Blackwell Publishing Ltd.

SPSS. (2016). SPSS for windows statistical package for social studies software (SPSS, 2016) Version 24.

Storm, B. L.; Schinnar, R.; Ziegler, E. E.; Barnhart, K. T.; Sammel, M. D.; Macones, G. A.; Stallings, V.A.; Drulis, J. M.; Nelson, S. E. and Hanson, S. A. (2001). Exposure to Soy Based Formula in Infancy and Endocrinological and Reproductive Outcomes in Young Adulthood. JAMA, 286,807-814.

Sumarna (2008). Changes of raffinose and stachyose in soy milk fermentation by lactic acid bacteria from local fermented foods of Indonesian. Malaysian J. Micro., 4, 26- 34.

Sun, E. and Young, I. (2008). Stability and shelf life of bioactive compounds during food processing and storage: Soy isoflavones. J. Food Sci. 69: R160–R166.

Swelam, S. (2018). Impact of high hydrostatic pressure on composition and quality of yoghurt. Food Dairy Sci., Mansoura Univ., 9: 31- 35.

Swelam, S.; Rashed, M. A.; Hatem, H. E. and khames, E. F. (2019). Properties of non-fat yoghurt as influenced by the incubation temperature of exopolysaccharide producing culture. J. of Food and Dairy Sci., Mansoura Univ., 10: 447-452.

Tamime, A. Y. and Robinson, R. K. (1999). Yoghurt Science and Technology, (2nd ed). Exeter, England: A. Wheaton and Co. Ltd./Pergamon Press Ltd.

Tuflikha, P. P. (2017). Understanding Thermophilic Spore-forming Bacteria in Milk Powders. Ph.D thesis, food safety department, University of Tasmania.

Varo, P.; Nuurtamo, M.; Saari, E. and Koivistoinen, P. (1980). Mineral element composition of Finnish Foods VIII. Dairy products, eggs, and margarine. Acta Agric. Scandi., Supple., 22: 115-126.

Yadav, D.N., Chauhan, G.S., Chauhan, O.P., Sharma, P. and Bajpai, A. (2003). Quality evaluation of curd prepared from milk soymilk blends. J. Food Sci., Technol., 40: 403-405.

Yang, M.; Li, L. (2010). Physicochemical, textural and sensory characteristics of probiotic soy yogurt prepared from germinated soybean. Food Technol Biotechnol., 48: 490-496.

Zanhi, N. K. and Jideani, I. A. (2012). Physico-chemical and sensory qualities of soy and milk solids fortified low-fat yoghurt. Afr. J. Agric. Res., 7: 5336-5343.

الجودة والخصائص الكيموفيزيائية لليوغورت المدعم بمسحوق فول الصويا واللبن الفرز المجفف

سهام سويلم عبدالحميد محمد[1]*ونبيل محمد يوسف مهنا[1] و وليد محمد فرج الله عمر [1]و سوسو مسعد أحمد العصفوري[2] و عبدالعزيز محمود عبدالعزيز عبد القادر[1]

[1] قسم علوم الالبان - كليه الزراعة - جامعة كفر الشيخ

[2]مركز البحوث الزراعية - معهد بحوث تكنولوجيا الأغذية- مصر , الكلية الجامعية بالخرمة - جامعة الطائف - لمملكة العربية السعودية

الملخص

أجرى هذا البحث بهدف دراسة تأثير تدعيم اللبن البقري المعد لصناعة اليوغورت بمسحوق فول الصويا واللبن الفرز المجفف على تركيب وجودة اليوغورت الناتج. حيث تم تصنيع اليوغورت من اللبن البقري ونسب مختلفة من اللبن الفرز المجفف ومسحوق فول الصويا ومقارنته باليوغوت المصنع من لبن بقرى بدون أى اضافات. وقد وجد من النتائج المتحصل عليها أن مدة التخمير طالت بزيادة كمية مسحوق فول الصويا المستخدم. كما أدي إضافة تركيزات مختلفة من مسحوق فول الصويا و اللبن الفرز المجفف إلى زيادة محتوى الجوامد الصلبة الكلية والبروتين بشكل ملحوظ. بينما أدى إضافة مسحوق فول الصويا بتركيز 3٪ مع 1٪ من اللبن الفرز المجفف إلى زيادة ($P \leq 0.05$) محتوى من الدهن. هذا وقد أدى التدعيم بمركزات بروتين فول الصويا واللبن الفرز المجفف إلى زيادة محتوى اليوغورت من الحديد؛ البوتاسيوم والزنك. كما اتصف اليوغورت المدعم بمسحوق فول الصويا و اللبن الفرز المجفف بقوة جذب خثرى أكبر وكانت الفروق معنوية إحصائيا ($P \leq 0.05$) ما بين اليوغورت المدعم غير المدعم في حين كان معدل طرد الشرش من الخثرة أقل نتيجة تأثير التدعيم بالمواد محل الدراسه. حيث أدى إضافة 4% من اللبن الفرز المجفف لأقل معدلات من التشريش. أظهرت نتائج التحليل الميكروبيولوجي انخفاض في اعداد البكتريا الكلية بإضافة اللبن الفرز المجفف ومسحوق فول الصويا وكذلك انخفضت اعداد البكتيريا اللاهوائية بصورة معنوية ($P \leq 0.05$) بإضافة 3 % من مسحوق فول الصويا و1 % من اللبن الفرز المجفف؛ بينما ازدادت اعداد البكتيريا المتجرثمة الهوائية زيادة معنوية ($P \leq 0.05$) في كل المعاملات مقارنة بالعينة فير المعاملة(المقارنة).كما أوضحت نتائج التقييم الحسي زيادة معنوية ($0.05 \geq P$)) فى الخواص الحسيه في المعاملات التي تزيد فيها إضافة اللبن الفرزالمجفف.

الكلمات الداله: يوغورت، وقت التجبن، المحتوي المعدني