FACULTY OF AGRICULTURE

Minia J. of Agric. Res. & Develop.
Vol. (42), No.2, pp. 111 -126, 2022

THE USE OF SOYBEAN PROTEIN HYDROLYSATE FOR MANUFACTURING NON-FAT BIO-YOGHURT

Heba. M. AL-Sagher*, Karima A. H. Saleh and A.S. Zahran
Diary Science Department, Faculty of Agriculture, Minia University, Minia, Egypt
* Correspondence: hebashawkey@mu.edu.eg

Received: 31 July 2022 Accepted: 14 August 2022

ABSTRACT

Soybean protein hydrolysate was used to manufacture non-fat set yoghurt, it was added to milk in a range between 3-20%. Results showed that the best ratio of soybean hydrolysate to be used as fat substitute to manufacture non-fat yoghurt was 5% and 10% respectively. Addition of soybean hydrolysate decreased the coagulation time of yoghurt samples; the higher decrease was noticed when 10% of soybean hydrolysate was used, the coagulation time decreased from 4.20h to 3.15h. Addition of soybean hydrolysate to skim milk increased the growth of both probiotic bacteria and yoghurt culture, and also improved the water holding capacity of produced yoghurt. Addition of 10% soybean protein hydrolysate increased the quantities of acetaldehyde from (15.41-27.50ppm), diacetyl from (0.116-0.171expressed as O.D at 540 nm), and acetoin from (0.159- 0.220 expressed as O.D at 540 nm). Addition of 5% soybean protein hydrolysate increased the acetoin content from (0.144 ± 0.002-0.160 ± 0.002 expressed as O.D at 540 nm). Storage of yoghurt samples for 7 days increased the amount of acetoin produced from (0.160 ± 0.002 to 0.239 ± 0.002 expressed as O.D at 540 nm) when 5% soybean hydrolysate was added. So, non-fat yoghurt with 5% soybean hydrolysate could be used for the manufacture of acceptable bio-yoghurt. Finally, the addition of 5% soybean protein hydrolysate improved the sensory properties of set-style yoghurt.

***keywords**:* Probiotic, Prebiotic, Soybean hydrolysate, Bio-yoghurt

INTRODUCTION

Yoghurt is a cultured dairy product that is widely consumed as a healthy food. It is a multi-component gel system that contains protein, polysaccharide, and lipids. It is a fermented dairy product obtained by Lactic acid bacteria (*Streptococcus thermophilus* + *Lactobacillus delbrueckii ssp bulgaricus).* These bacteria were used for the traditional fermentation of milk yoghurt **(Tamime& Robinson, 1999)**.

Soybean protein hydrolysate can be obtained by using different methods, including enzymatic hydrolysis, thermal treatments as well as biological processes such as gastrointestinal digestion and microbial fermentation **(Ashaolu, 2020)**. Enzymatic hydrolysis is preferred in comparison with chemical methods **(Chiang et al, 1999)**. This method can modify whole proteins into peptides, providing them with added functional and nutritional benefits **(Hartmann & Meisel, 2007)**. It has been reported that soybean hydrolysate reduced fermentation time and increased the viability of Lactic acid bacteria and bifidobacteria, it was also found that antioxidant is the most important benefit of soybean bioactive peptides **(Coscueta et al, 2016**). Soybean is a trendy prebiotic used for sustaining several probiotics present in the gut **(Rastall & Maitin, 2002)**.

Probiotic bacteria are defined as "live micro-organisms that, when administered in sufficient quantities, confer a health benefit on the host **(De Souza Oliveira et al, 2011; Chaudhari & Dwivedi, 2022)**.

Probiotic bacteria are adjuncts that are added to fermented milks like yoghurt. When added to yoghurt, they increase the health benefit of the yoghurt produced, which is called bio-yoghurt. The majority of bacteria with probiotic properties belong the genera *Lactobacillus* and *Bifidobacterium* (**Vasiljevic & shah, 2008)**. Prebiotics are non-digestible carbohydrates that are resistant to metabolism in the upper part of the gastrointestinal tract. Eventually prebiotics reach the colon where they were selected for metabolism by probiotic bacteria. Prebiotics added to yoghurt with probiotic bacteria to enhance the growth of both Lactic acid bacteria and probiotic bacteria.

So, the aim of this work was to study the possibility of using soybean protein hydrolysate as a prebiotic in manufacturing of non-fat set yoghurt as well as its effect on the chemical composition, bacterial content, antioxidant properties and sensory qualities of the produced bio-yoghurt.

MATERIALS AND METHODS

2.1 preparation of soy milk

Dry whole soybean **(Giza 101)**, obtained from the Ministry of Agriculture, Minia governorate was used to prepare soy milk as described by **(Afroz et al, 2016)**.

2.2 preparation of soybean protein isolate (SPI)

Soybean protein isolate (SPI) was prepared by the method described by **Puppo et al, (2004)**.

2-3 preparation of pepsin soy protein hydrolysate

Pepsin hydrolysate was prepared according to the method described by **(Irshad et al, 2015)**.

2.4 Determination of the degree of hydrolysis (DH)

The hydrolysis degree of soy protein hydrolysate was measured by the o-phthaldialdehyde (OPA) method as described by **(Nielsen et al, 2001)**.

2.5 Manufacture of yoghurt

Yoghurt was manufactured according to the method described by **(Ibrahim, 2005)**. Seven treatments were used in this research as follows:

1- Cow's milk containing 3% fat as a control (C).2- Non-fat cow's milk ($C_{1)}$. 3-

Non-fat cow's milk with *Bifidobacterium bifidum* (C_2).4- Non-fat cow's milk (NFY) +5% soybean hydrolysate (T_1).5- Non-fat cow's milk supplemented with 5% soybean hydrolysate + Bifidobacteria (T_2). 6- Non-fat cow's milk supplemented with 10% soybean hydrolysate (T_3).7- Non-fat cow's milk supplemented with 10% soybean hydrolysate +Bifidobacteria (T_4). Different treatments were heated at 90°C for 15 min, then cooled to 42±1°C before being inoculated with 2% of starter culture+ bifidobacteria, filled in plastic cups (100 ml). The milk was then incubated at 42°1°C until a uniform coagulation was achieved. Yoghurt samples were kept at 4°C ±1 and analysed as fresh and after 3, 5 and 7 days of manufacturing. Results obtained in this study are the average of three replicates.

2.6 Chemical analysis:

2.6.1. pH determination, Titratable acidity and Total Solids:

was determined according the method described by **Ling, (1963**).

2.6.2. Determination of total protein:

Total nitrogen was determined by kjeldahl method as described by **AOAC, (1984)**.

2.6.3 Fat content:

Fat content of milk and yoghurt samples was determined as described by **AOAC, (1984)**.

2.6.4 Determination of acetaldehyde:

Acetaldehyde content was determined as described by **(Yılmaz, 2006)**.

And expressed as pm

$$A= \frac{44 \times N \times V}{M} \times 100$$

Where:

A= Acetaldehyde amount, ppm

V= Used 0,005 N iodine solution during titration, mL

N= Normality of used iodine solution in titration

m = Sample weight, gram

2.6.5 Determination of diacetyl and acetoin

Diacetyl and acetoin were determined using the standard solutions of actoin and diacetyl prepared according to **Westerfeld, (1945)**. The results as expressed as O.D at 540 nm.

2.6.6 Determination of curd firmness

The firmness of the formed gel was determined using the peneteration method described by **(Ibrahim, 1983**).

2.6.7 Water holding capacity (WHC):

The susceptibility of yoghurt to water holding capacity was determined using the method described by **Keogh & O'Kennedy, (1998)**, with the following modifications 50 ml conical plastic tubes (falcon type) 45 g of yoghurts (*Y*) were centrifuged at 3000 g for 20 min at 4°C. The clear supernatant (*W*) was poured off, weighed and the water-holding capacity (WHC, 100g) was calculated as:

$$\mathbf{WHC = (Y - W)/Y \times 100.}$$

Where:

Y= 45 g of yoghurts

W= The clear supernatant

2.6.8 Measurement of syneresis

Yoghurt syneresis (the released of whey) was determined by the centrifugation method described by **Keogh & O'Kennedy, (1998)**. Yoghurt (20g) was centrifuged (at 640g, 20min, 4˚C) and the clear supernatant was harvested and weighed. Syneresis was calculated according to the following equation

$$\text{Syneresis (\%)} = \frac{\text{weight of supernatant (g)} \times 100}{\text{Weight of yogurt sample (g)}}$$

2.7 Determination of antioxidants

2.7.1 Total flavonoid compounds:

Total flavonoid compounds were determined using the aluminium chloride colorimetric method as described by **Kim et al, (2003)**.

2.8 Bacterial counts

Lactic acid bacterial counts were determined using MRS agar media **Richardson, 1985)**. Total viable bifidobacteria were enumerated as described by **Venting & Mistry** (**1993**). The specific growth rate (K) was calculated as described by (**Kamaly, 1997**).

2.9 Sensory evaluation:

Sensory evaluation of yoghurt samples was measured as described by **(Giri, 2013)**. As fallows:

1	Very bad
2	Bad
3	Accepted
4	Good
5	Very good

2.10 Statistical analysis

Data collected were subjected to two-way Analysis of Variance (ANOVA). The differences were separated using the Least Significant Difference (LSD) **(Motulsky, 1999)**.

3- RESULTS AND DISCUSSION

The fat content of yoghurt cow milk samples was 3%; on the other hand, the fat content of skimmed milk yoghurt samples was 0.3%. Protein content in yoghurt samples were in the average of 3.39%, when 10% soybean hydrolysate was added the protein value increased up to 5.56%. Total solids were 12.56 in full fat yoghurt samples and this value was reduced in control C and control C1. Addition of soybean hydrolysate to yoghurt samples (T1 to T4) led to an increase of total solids to 11.9 and 12.4, in yoghurt samples supplemented with 5% and 10% soybean hydrolysate respectively. The chemical composition of yoghurt samples was within the range reported by other researchers (**El-Galeel et al, 2017 and Kebary et al, 2020**)

The chemical composition of yoghurt samples was mentioned in Table (1)

3.1 pH & acidity

The pH values and titratable acidity of yoghurt samples when fresh and during storage at 4°C±1 is shown in **Table (2).** The pH values were in the range between 4.46-4.58 at day 1. These values were decreased during storage at 4°C±1and the pH values ranged between 4.32-4.45. Similar changers were found in titratable acidity of yoghurt samples during storage at 4°C±1 ranging from (0.76-0.85%) at day 1 to the range between (0.86-0.95%) at day 7. Addition of soybean hydrolysate had an effect on the values of pH and titratable acidity. It was quite noticeable that the changes in pH (ΔpH) were higher in samples with 5% and 10% soybean hydrolysate. Soybean hydrolysate probably contained small peptides and free amino acids which promote the growth of both probiotic bacteria and yoghurt cultures (results in **Table (2)** confirmed this observation). The results obtained in this study were in agreement with that obtained by- **Tavakoli et al, (2019)**.

3.2 Water holding capacity (WHC)

Water holding capacity of yoghurt is mainly related to the ability of protein and fat globules to retain water **(Tamime& Robinson, 1999)**.

Results in **Table (3)** show changes in water holding capacity (WHC) of yoghurt samples during storage at 4°C±1. Addition of soybean hydrolysate led to decease in the WHC. The obtained data revealed that there were significant differences (P≤0.05) during storage for 7 days at 4°C±1.

3.3 Curd firmness:

Changes in the firmness of manufactured yoghurt over 7 days of storage are shown in **Table (4).**

The results obtained in **Table (4)** show that the lowest were values noted with non-fat yoghurt, samples $C_1$and C_2. Soybean hydrolysate increased the firmness of the yoghurt throughout the storage period. It was increased from 27.5 to 33.5g) in the treatment T_2 and from 26.4 to 31.7 in the treatment (T_4). Soybean hydrolysate increased the firmness, probably due to the formation of a higher cross linkage with casein network in yoghurt. It seems also that soybean hydrolysate penetrates into the casein micelle network increasing yoghurt firmness During storage the firmness was increased due to the change in the strength and type of casein interactions with the decrease in pH **(Walstra, 1998)**.

3.4 Syneresis

Data in **Table (5).** Show that syneresis increased by the reduction of fat.

On the other hand, fortification of yoghurt with soybean hydrolysate reduced syneresis. Results presented in **Table (5)** showed that the treatments and storage periods had a significant (P≤0.05) effect on syneresis of yoghurt. The highest value of syneresis (10.12±0.02) was found in C_1 followed by C and C2 (9.52±0.02 and 9.23±0.02), however T4 gave the lowest value (7.52±0.02) after 1 day of storage at 4°C±1. Similar results were found by **Habibi et al, 2019; Oliveira et al, 2021**).

Reduction in syneresis was enhanced in yoghurt samples with both soybean hydrolysate and probiotic bacteria. **Ibrahim et al, (2020)** reported that *Bifidobacterium bifidum*___produced exopolysaccharides which have influence the syneresis and WHC of non-fat yoghurt but less than soybean hydrolysate.

3.5 Total flavonoids content (TF C)

The total amount of flavonoids (TFC) was (13.1, 11.54, 16.9, 47.7, 48.5, 70.8 and 72.31 mg/100g) for (C, C_1, C_2, T_1, T_2, T_3, and T_4) respectively after one day of storage at 4°C±1. During storage TFC decreased steadily till the end of the storage period. Non-fat yoghurt supplemented with 10% soybean hydrolysate resulted a higher TFC (T_4) 72.31 mg/100g in comparison with the control yoghurt (13.1 mg/100g). Data obtained in this study revealed that, significant differences in TFC (P≤0.05) were found during the storage of yoghurt samples.

3.6 Viability of bacteria

The total viable count of probiotic bacteria and starter culture was determined in **Table (7)**.

Results obtained in this study show that, soybean hydrolysate increased the viability of LAB as well as probiotic bacteria compared to the control samples. It has been reported that soybean protein hydrolysate with molecular weight Less than 5 KDa could significantly enhance the growth of bacteria (**Zhao et al, 2013)**.

Soybean hydrolysate improved the viability of LAB and probiotic bacteria during storage period and these results are in good agreement with the results obtained by **Hu et al, (2020)**.

3.1 Sensory evaluation

The effect of adding soybean hydrolysate on the organoleptic properties of yoghurt is presented in **Table (8)**

Results obtained in this study showed that using soybean hydrolysate with or without probiotic bacteria enhanced the body and the texture of T1 and T2, compared with non-fat yoghurt C1. The organoleptic properties of yoghurt were markedly decreased by increasing the ratio of soybean hydrolysate above 10%.

Conclusion using soybean hydrolysate with probiotic bacteria in association with common yoghurt culture could be used for the manufacture of acceptable non-fat yoghurt. Up to 10% soybean hydrolysate may be used with or without probiotic bacteria for making stirred or drinking yoghurt as a type of functional food, however the beast ratio of soybean hydrolysate to be added was 5% to manufacture acceptable non-fat bio-yoghurt.

Table (1) Chemical composition of yoghurt Samples

	Control C	***Control C***	***Control C1***	***T1***	***T2***	***T3***	**T4**
Fat %	3	0.3	0.3	0.3	0.3	0.3	0.3
Protein%	3.39	3.39	3.39	4.45	4.45	5.56	5.56
Total solids%	12.56	10.2	10.2	11.9	11.9	12.4	12.4

C = full fat yoghurt, C1= non-fat yoghurt, C2= non-fat yoghurt+ probiotic
T1= non-fat yoghurt+ soybean hydrolysate (5%), T2= non-fat yoghurt+ soybean hydrolysate (5%) + probiotic, T3= non-fat yoghurt+ soybean hydrolysate (10%)
T4= non-fat yoghurt+ soybean hydrolysate (10%) + probiotic.

Table (2): Changes in pH and titratable acidity of yoghurt samples during storage at 4°C± ١

Treatments	Storage period (Days)	TA%	pH	Δ pH
full fat yoghurt control (C)	Zero	0.76	4.60	______
	1	0.79	4.58	0.02
	3	0.82	4.52	0.08
	5	0.85	4.48	0.12
	7	0.86	4.44	0.16
Non- fat yoghurt control (NFY) (C1)	Zero	0.75	4.59	______
	1	0.79	4.56	0.03
	3	0.82	4.52	0.07
	5	0.85	4.47	0.12
	7	0.88	4.45	0.14
NFY+ Probiotic (C2)	Zero	0.77	4.58	______
	1	0.78	4.54	0.04
	3	0.85	4.49	0.09
	5	0.87	4.44	0.14
	7	0.89	4.39	0.19
NFY+ Soy protein hydrolysate (SPH) (5%) (T1)	Zero	0.79	4.56	______
	1	0.82	4.55	0.04
	3	0.86	4.49	0.1
	5	0.89	4.44	0.15
	7	0.91	4.38	0.21
NFY+(SPH) (٥%) + Probiotic (T2)	Zero	0.79	4.57	______
	1	0.84	4.52	0.05
	3	0.88	4.46	0.11
	5	0.90	4.40	0.17
	7	0.93	4.34	0.23
NFY+ Soy protein hydrolysate (SPH) (10%) (T3)	Zero	0.79	4.52	______
	1	0.84	4.48	0.04
	3	0.86	4.42	0.1
	5	0.89	4.38	0.14
	7	0.92	4.36	0.16
LFY+(SPH) (10%) + Probiotic (T4)	Zero	0.80	4.52	______
	1	0.85	4.46	0.06
	3	0.87	4.40	0.12
	5	0.92	4.36	0.16
	7	0.95	4.32	0.2

TA Titratable acidity

Table (3): Changes in water holding capacity (WHC) of yoghurt samples during storage at 4°C± ١

Treatments	STORAGE (Day)			
	S1	**S3**	**S5**	**S7**
full fat yoghurt control (C)	54.13^{hi} ±0.02	55.80^{ef} ±0.03	57.81^{ab} ±0.02	56.80^{cd} ±0.04
Non- fat yoghurt control (NFY) (C1)	52.11^{l} ±0.02	53.50^{ij} ±0.02	54.13^{hi} ±0.02	55.68^{ef} ±0.02
NFY+Probiotic (C2)	52.32^{l} ±0.1	53.13^{jk} ±0.02	55.24^{fg} ±0.02	56.13^{de} ±0.02
NFY+Soy protein hydrolysate (SPH)(5%) (T1)	53.42^{ij} ±0.02	56.26^{de} ±0.02	57.53^{bc}±0.02	58.52^{a} ±0.02
NFY+SPH(5%)+Probiotic (T2)	52.50^{kl} ±0.03	54.50^{gh} ±0.02	55.91^{ef} ±0.02	57.48^{c} ±0.02
NFY+Soy protein hydrolysate (SPH)(10%) (T3)	50.30^{m} ±0.02	53.46^{ij} ±0.03	55.91^{ef} ±0.02	58.48^{a} ±0.02
NFY+SPH(10%)+Probiotic (T4)	49.80^{m} ±0.02	54.48^{gh} ±0.02	56.40^{de} ±0.02	57.92^{ab} ±0.9

Table (4): Changes in curd firmness(g) of yoghurt samples during storage at 4°C± ١

Treatments	STORAGE (Day)			
	S1	**S3**	**S5**	**S7**
full fat yoghurt control (C)	28	30.2	32.8	34.6
Non- fat yoghurt control (NFY) (C1)	25.6	27.4	28	29.5
NFY+Probiotic (C2)	26.2	27.9	28.7	30.4
NFY+Soy protein hydrolysate (SPH)(5%) (T1)	26.8	28.9	31.1	32.50
NFY+SPH(5%)+Probiotic (T2)	27.5	29.1	32.60	33.5
NFY+Soy protein hydrolysate (SPH)(10%) (T3)	26.1	27.6	28.2	30.8
NFY+SPH(10%)+Probiotic (T4)	26.4	27.8	28.6	31.7

Table (5): Changes in syneresis of yoghurt samples during storage at 4°C± ١

Treatments	STORAGE (Day)			
	S1	S3	S5	S7
full fat yoghurt control (C)	9.52^{b}± 0.02	8.42 ^{c} ±0.02	7.88^{def}±0.02	6.92^{i}±0.02
Non- fat yoghurt control (NFY) (C1)	10.12^{a}±0.02	9.42^{b}±0.02	8.25^{cd}±0.02	7.19^{hi}±0.02
NFY+Probiotic (C2)	9.23^{b}±0.02	8.27^{cd}±0.02	7.42^{gh}±0.02	6.78^{i}±0.02
NFY+Soy protein hydrolysate (SPH)(5%) (T1)	8.12^{cde}±0.02	7.67^{efg}±0.02	6.74^{i}±0.02	5.82^{jk}±0.02
NFY+SPH(5%)+Probiotic (T2)	7.84^{defg}±0.02	6.76^{i}±0.02	5.82^{jk}±0.02	5.56^{k}±1.15
NFY+Soy protein hydrolysate (SPH)(10%) (T3)	7.92^{def}±0.02	5.75^{jk}±0.03	5.74^{jk}±0.02	4.92^{l}±0.02
NFY+SPH(10%)+Probiotic (T4)	7.52^{fgh}±0.02	6.23^{j}±0.02	6.08^{j}±1.15	4.24^{m}±0.9

Table (6): Concentration of Total flavonoid content (mg/100g) in yoghurt samples during storage at 4°C±1

Treatments	STORAGE (Day)			
	S1	S3	S5	S7
full fat yoghurt control (C)	13.07^{i}± 0.02	11.53^{i}±0.02	10.77^{i}±0.02	9.23^{ij}±0.02
Non- fat yoghurt control (NFY)(C1)	11.53^{i}±0.02	10.75^{i}±0.02	9.23^{ij}±0.02	5.38^{j}±0.02
NFY+Probiotic (C2)	16.92^{h}±0.02	13.07^{i}±0.02	10.76^{i}±0.02	9.24^{ij}±0.02
NFY+Soyprotein hydrolysate (SPH)(5%) (T1)	47.69^{cd}±0.02	34.61^{f}±0.02	31.53^{f}±0.02	23.07^{g}±0.02
NFY+SPH(5%)+Probiotic (T2)	48.46^{c}±0.02	40.76^{e}±0.02	32.30^{f}±0.02	23.84^{g}±0.02
NFY+Soyprotein hydrolysate (SPH)(10%) (T3)	70.76^{a}±0.02	62.3^{b}±0.02	43.84^{de}±0.02	30.76^{f}±0.02
NFY+SPH(10%)+Probiotic (T4)	72.33^{a}±0.09	63.07^{b}±0.02	44.30d^{e}±0.02	45.38^{cd}±0.02

Table (7). Change of Viable lactic acid bacteria (*Lactobacillus delbrueckii ssp bulgaricus*+ *Streptococcus thermophilus*) and *Bifidobacterium bifidum* count in yoghurt samples during storage at 4°C± ١ for 7days

Treatments	**Storage period (Days)**	***Lactobacillus Bulgaricus Log CFU/ml***	***Streptococcus thermophilus Log CFU/ml***	***Bifidobacterium bifidum Log CFU/ml***
full fat yoghurt control (C)	1	6.9	5.9	————
	3	7.8	6.8	
	5	8.8	7.6	
	7	9.8	8.7	
Non- fat yoghurt control (NFY) (C1)	1	6.6	5.4	————
	3	7.6	6.5	
	5	8.8	7.7	
	7	9.7	8.8	
NFY+ Probiotic (C2)	1	7.8	6.8	8.8
	3	8.6	7.6	9.7
	5	9.9	8.9	9.9
	7	10.02	9.96	9.6
NFY+ Soy protein hydrolysate (SPH) (5%) (T1)	1	10.02	9.01	————
	3	11.06	10.06	
	5	12.11	11.11	
	7	13.14	12.14	
NFY+SPH (5%) +Probiotic (T2)	1	10.9	9.9	8.9
	3	12.03	10.01	11.02
	5	13.07	11.07	12.07
	7	14.13	12.13	13.07
NFY+ Soy protein hydrolysate (SPH) (10%) (T3)	1	11.09	10.02	————-
	3	12.06	11.01	
	5	13.07	12.07	
	7	14.15	13.13	
NFY+SPH (10%) +Probiotic (T4)	1	11.06	10.06	8.98
	3	12.07	11.07	11.03
	5	13.10	12.10	12.07
	7	14.15	13.14	13.08

Table (8): Sensory properties of yoghurt with different levels of soybean hydrolysate during storage at 4°C±1

Sample	Color	Taste Aroma	Texture	Acceptability
full fat yoghurt control (C)	5	4	5	5
Non- fat yoghurt control (NFY) (C1)	5	3.5	4	4
NFY+ Probiotic (C2)	5	4	4	4
NFY+ Soy protein hydrolysate (SPH) (5%) (T1)	5	4	5	5
NFY+SPH (5%) +Probiotic(T2)	5	4	5	5
NFY+ Soy protein hydrolysate (SPH) (10%) (T3)	4	3	3	3
NFY+SPH (10%) +Probiotic(T4)	4	3	3	3

REFERENCES

Afroz, M.F., W. Anjum, N. Islam, A. Kobir, K. Hossain and A. Sayed. 2016. Preparation of soymilk using different methods. J. Food Nutri. Sci. 4(1): 11-17.

AOAC., 1984. Official methods of analysis, 14th ed. Association of Official Agricultural Chemists,Washington, D.C.

Ashaolu, T. J. (2020). Applications of soy protein hydrolysates in the emerging functional foods: a review. International Journal of Food Science & Technology, *55*(2), 421-428.

Chaudhari, A., & Dwivedi, M. K. (2022). The concept of probiotics, prebiotics, postbiotics, synbiotics, nutribiotics, and pharmabiotics. In *Probiotics in the prevention and management of human diseases* (pp. 1-11). Academic Press.

Chiang WD, Shih CJ, and Chu YH. 1999. Functional properties of soy protein hydrolysate produced from a continuous membrane reactor system. Food Chemistry 65:189-194.

Coscueta, E. R., Amorim, M. M., Voss, G. B., Nerli, B. B., Picó, G. A., & Pintado, M. E. (2016). Bioactive properties of peptides obtained from Argentinian defatted soy flour protein by Corolase PP hydrolysis. Food Chemistry, 198,36–44.

De Souza Oliveira, Ricardo Pinheiro, Perego, Patrizia, De Oliveira, MaricÃª Nogueira, & Converti, Attilio. (2011). Effect of inulin as a prebiotic to improve growth and counts of a probiotic cocktail in fermented skim milk. LWT-Food Science and Technology, 44(2), 520-523.

El-Galeel, A., Ali, A., Atwaa, E. H., & Abdelwahed, E. M. (2017). IMPROVING PROPERTIES OF NON-FAT YOGHURT USING FAT REPLACERS. Zagazig Journal of Agricultural Research, 44(2), 583-590.

Giri, A. (2013). Development of Funtional Processed Cheese Spreads Using Plant Derived Ingredients (Doctoral dissertation, NDRI).

Habibi Najafi, M. B., Fatemizadeh, S. S., & Tavakoli, M. (2019). Release of proteolysis products with ACE-inhibitory and antioxidant activities in probiotic yogurt containing different levels of fat and prebiotics. International Journal of Peptide Research and Therapeutics, 25(1), 367-377.

Hartmann R and Meisel H. 2007. Food-derived peptides with biological activity: from research to food applications. Curr Op Biotech 18:163-169.

Hu, Y., Li, Y., & Liu, X.(2020). Soybean peptides promote yoghurt fermentation and quality. *Biotechnology Letters*, *42*(10), 1927 - 1937.

İbrahim, A. A. E. G., El-sayed, E., El-zeini, H., & HM, S. (2005). The hypocholesterolemic effect of milk yogurt and soy-yogurt containing bifidobacteria in rats fed on a cholesterol-enriched diet. *Int Dairy J*, *15*, 37-44.

Ibrahim, F.S. (1983) Studies on the Micellar Structure of Buffaloes

Casein. M.Sc. Thesis, Minia University, Minya.

Ibrahim, M., Barakova, N., & Jõudu, I. (2020). Enrichment of the low-fat yoghurt with oat β-glucan and EPS-producing Bifidobacterium bifidum improves its quality.

Irshad, I., Kanekanian, A., Peters, A., & Masud, T. (2015). Antioxidant activity of bioactive peptides derived from bovine casein hydrolysate fractions. Journal of Food Science and Technology, 52(1), 231-239.

Kamaly, K.M (1997). Bifidobacteria fermentation of soybean milk. Food Res Inter, (30) 9:675-682.

Kebary, K. M. K., Husien, S. A., Badawi, R. M., & Habib, M. A. M. (2020). Impact of fortifying COW'S milk with whey protein hydrolysate on yoghurt quality. Menoufia Journal of Food and Dairy Sciences, 5(5), 65-77.

Keogh, M. K., & O'kennedy, B. T. (1998). Rheology of stirred yogurt as affected by added milk fat, protein and hydrocolloids. Journal of food science, 63(1), 108-112.

Kim, D. O., Jeong, S. W., & Lee, C. Y. (2003). Antioxidant capacity of phenolic phytochemicals from various cultivars of plums. Food chemistry, 81(3), 321-326.

Ling, E. R. (1963). Dairy Chemistry, Vol. II, Practical. Chapman and Hall, London.

Motulsky, H.J. (1999) Analyzing data with Graphpad Prism. San.Diego.Graphpad software INC.

Nielsen, P. M., Petersen, D., & Dambmann, C. J. J. O. F. S. (2001). Improved method for determining food protein degree of hydrolysis. Journal of food science, 66(5), 642-646.

Oliveira Lima, K., Rocha, M. D., Alemán, A., López Caballero, M. E., Tovar, C. A., Guillén, G., ... & Prentice, C. (2021). Yogurt fortification by the addition of microencapsulated stripped weakfish (Cynoscion guatucupa) protein hydrolysate.

Puppo, C., Chapleau, N., Speroni, F., de Lamballerie-Anton, M., Michel, F., Añón, C., & Anton, M. (2004). Physicochemical modifications of high-pressure-treated soybean protein isolates. Journal of Agricultural and Food Chemistry, 52(6), 1564-1571.

Rastall, Robert A., & Maitin, Vatsala. (2002). Prebiotics and synbiotics: Towards the next generation. Current Opinion in Biotechnology, 13(5), 490-496.

Richardson, G. H. 1985. Standard methods for the analysis of dairy products. 15th edition. American Public Health Association, Washington, D.C., USA.

Tamime, A.Y, Robinson, R.K. (1999). Historical Background In: Yoghurt: Science and Technology. 2nd ed. CRC Press, Boca Raton, FL. p. 7-8.

Tavakoli, M., Najafi, M. B. H., & Mohebbi, M. (2019). Effect of the milk fat content and starter culture selection on proteolysis and antioxidant activity of probiotic yogurt. Heliyon, 5(2), e01204.

Vasiljevic, T., & Shah, N. P. (2008). Probiotics—from Metchnikoff to bioactives. International Dairy Journal, 18(7), 714-728.

Walstra, P. 1998. Relation between structure and texture of cultured milk products. In: Texture of Fermented Milk Products and Dairy Desserts. Special Issue 9802. International Dairy Federation, Brussels. pp. 9-15.

Westerfeld WW (1945) A colorimetric determination of blood acetoin. J Biol Chem 161:495-502.

Yılmaz, L. (2006). Yogurt Benzeri Fermente Süt Urünleri Uretiminde Farklı Probiyotik Kültür Kombinasyonlarının Kullanımı (Doctoral dissertation, Bursa Uludag University (Turkey).

Zhao, J., Xiong, Y. L., & McNear, D. H. (2013). Changes in structural characteristics of antioxidative soy protein hydrolysates resulting from scavenging of hydroxyl radicals. Journal of Food Science, 78(2), C152C159.http://dx.doi.org/10.1111/1750-3841.12030. PMid:23331209.

.

الملخص العربي

استخدام متحلل بروتين فول الصويا في تصنيع الزبادي الحيوي الخالي من الدسم

هبه محمد الصغير، كريمة عبد الحميد حسنين، أحمد شوقي زهران

قسم الالبان – كلية الزراعة – جامعة المنيا

استخدم متحلل بروتين فول الصويا في صناعة زبادي خالي الدسم. تم اضافته بنسبة تتراوح ما بين (٣–٢٠%). النسب التي استخدمت في البحث هي ٥ و١٠ % فقط. أوضحت النتائج ان أحسن نسبة إضافة تستخدم كبديل للدهن هي ٥% و١٠، وجد ان إضافة متحلل فول الصويا يقلل من وقت التجبن واعلى انخفاض مع ١٠% متحلل فول الصويا. انخفض وقت التجبن من ٤,٢٠ ساعة الى ٣,١٥ ساعة. واضافة متحلل فول الصويا أدى الى زيادة نمو ونشاط بكتريا البادئ وبكتريا البروبيوتيك، أيضا أضافته أدت الي تحسين (WHC)، وأيضا أدى الى زيادة انتاج الاسيتالدهيد، (١٥،٤١–٢٧،٥٠)جزء في المليون، الداي اسيتيل (٠,١١٦–٠,١٧١)مقدر ككثافة بصرية عند طول موجي ٥٤٠ نانوميتر، الاسيتوين (٠,١٥٩–٠,٢٢٠) مقدر ككثافة بصرية عند طول موجي ٥٤٠ نانوميتر. كان محتوى الاسيتوين اعلى في عينات الزبادي مع متحلل فول الصويا من عينات الكنترول. أدى إضافة ٥% متحلل فول الصويا الى زيادة محتوى الاسيتوين من (٠,١٤٤ ±٠,٠٠٢) الى (٠,١٦٠±٠,٠٠٢) مقدر ككثافة بصرية عند طول موجي ٥٤٠ نانوميتر. أدى تخزين الزبادي لمدة ٧ أيام الى زيادة كمية الاسيتوين (٠,١٦٠ ±٠,٠٠٢) الى (٠,٠,٢٣٩±٠,٠٠٢) مقدر ككثافة بصرية عند طول موجي ٥٤٠ نانوميتر عند إضافة ٥% متحلل فول الصويا. لذلك يمكن استخدام ٥% متحلل فول الصويا في صناعة زبادي حيوي خالي من الدسم مقبول لدى المستهلك.