A STUDY ON YOGHURT FORTIFIED WITH MUSHROOM (*Agaricus Bisporus)*

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(Manuscript received 6 July 2015)

Abstract

Yoghurt fortification with nutritional and health valuable mushroom, in relation to its numerous attributes beyond its probiotic benefits was the aim of the studied. Yoghurt milk was supplemented with *Agaricus bisporus* at levels 0%, 5% and 10%. Thereafter, milk was inoculated with starter cultures, YC containing *Streptococcus themophilus* and *Lactobacillus delbrueckii ssp. bulgaricus,* YL containing *Streptococcus themophilus, Lactobacillus delbrueckii ssp. bulgaricus,* and *Lb. acidophilus,* YB containing *Streptococcus themophilus, Lactobacillus delbrueckii ssp. bulgaricus* and *Bifidobacterium* sp., and incubated at 42°C for complete coagulation (about 3 hr). There after, samples were kept at the refrigerator temperature (5±1°C) for 3 weeks. The obtained results indicated that, yoghurt fortified with mushroom was significantly distinguished with increased values of protein, ash, fiber, pH, curd tension, viscosity, amino acids, vitamins (riboflavin, niacin, B_{12}, biotin, B_1 and folate), minerals (Mg, K, Fe, Zn, P, Cu, Mn), organoleptic properiets and daily nutritional values (%). Also the total counts of *Str. themophilus, Lb. delbrueckii ssp. bulgaricus, Lb. acidophilus, Bifidobacterium* sp. were increased. While the values of fat, cholesterol, titratable acidity (T.A.%), Na and Ca were decreased. The best fortification level with mushroom was 10% and the best bacterial starter culture was *Bifidobacterium bifidum*. Prolonging cold storage period of all samples was associated with increasing values of T.A., curd tension and viscosity.

Finally, it was concluded that, yoghurt beyond its ability to be probiotic food *via* its culturing with the gut strains, it could further carry more healthy benefits when it was fortified with mushroom at any level up to 10%, but concerning bacteriological and organoleptic properties the level of 5% was preferable.

Key words: Mushroom, *Agaricus bisporus*, prebiotic, probiotics, yoghurt

INTRODUCTION

Yoghurt is a fermented milk product and generally a mixture of two species i.e. *Lactobacillus delbrueckii* ssp. *Bulgaricus and Streptococcus thermophilus* used. Usually it contains 12-14% total milk solids and has soft, friable custard like consistency with clean distinct acid flavor. Yoghurt supplies high quality protein and is an excellent source of calcium, phosphorus, potassium. It contains signtificant quantities of vitamins (Vinderola *et al*., 2000).

Edible mushrooms have been widely used as human food for centuries and have been appreciated for texture and flavours as well as some medicinal and tonic attributes. However, the awareness of mushrooms as a healthy food and as an important source of biological active substances with medicinal value has only recently emerged. Various activities of mushrooms have been studied which include antibacterial, antifungal, antioxidant, antiviral, antitumor, cytostatic, immunosuppressive, antiallergic, antiatherogenic hypoglycaemic, anti-inflammatory and hepatoprotective activities.Most researches are focused antioxidant and antitumor activities, (Lindequist *et al*., 2005).

Dietary fibers may play an important role in the prevention of some degenerative diseases e.g. coronary heart disease, stroke, hypertension, diabetes, obesity and certain gastrointestinal disorders. Furthermore, increased consumption of dietary fibers improved serum lipid concentrations, lowered blood pressure, improved blood glucose control in diabetes, promoted regularity, and improved immunety function. Dietary fibers can also impart some functional properties to foods, e.g., increase water and oil holding capacities, emulsifications and/or gel formation (Dervisoglu&Yazici 2006).

One way in which foods can be modified to become functional is by addition of probiotics. The word probiotic was originated from Greek word meaning "for life".Probiotic foods are defined as foods containing live microorganisms believed to activity enhance health by improving the balance of microflora in the gut. Prebiotics are non-digestible dietary components that pass through the colon and selectively stimulate the proliferation and/or activity of probiotic bacteria in the colon. Synbiotic is a product in which both a probiotic and prebiotic are combined in a single product. It is defined as a mixture of probiotics and prebiotics that beneficially affects the host by improving the survival and implantation of probiotic in gastrointestinal tract (Gibson, 1999).

In recent years, there has been a growing interest in using probiotic micro-organisms as dietary adjuncts in the dairy industry. Products have been developed and are on the market worldwide. Among the dairy products with live cultures, probiotics ice cream or fermented frozen desserts which, gaining popularity. Moreover, the growing demand for healthy foods is stimulating innovation and new product development in the food industry throughout the world (Mattila-Sandholm *et al*., 2002).

Therefore, the aim of this study was devoted to utilize of Mushrom in bio yoghurt manufacture to increase and improvement functional, healthy and nutritional properties.

MATERIALS AND METHODS

Materials

Milk:

Fresh buffalo's milk was obtained from the experimental station at Mahalet Moussa, Animal production Research Institute, Egypt. The milk was standardized to 4% fat.

Starter cultures:

Freeze dried conventional yoghurt starter culture (FD-DVS YC-X11) containing *Lactobacillus delbrueckii* ssp. *bulgaricus* and *Streptococcus thermophilus was* (YC), (La-5) contain *Lb. acidophilus* and (Bb-46) contain *Bifidobacterium bifidum* (B) were obtained from Chr. Hansen A/S, DK-2970 Horsholm, Denmark.

Mushroom (*Agaricus bisporus)* :

Mushroom was obtained from the local market in cairo, Egypt.

Table 1. The chemical composition of *Agaricus bisporus.*

Chemical composition	
Dry matter %	13.27
Fat %	0.242
Protein %	4.976
Ash %	1.798
Fiber %	2.057
Available Carbohydrates %	4.197
K (mg/100g Dw)	3422
P(mg/100g Dw)	8342
Mg (mg/100g Dw)	164
Zn (mg/100g Dw)	8.30
Cu (mg/100g Dw)	2.84
Fe (mg/100g Dw)	10.38
Mn(mg/100g Dw)	1.93
Riboflavin(B_2)(mg/100g Dw)	4.60
Niacin (mg/100g Dw)	54
Thiamin (B_1) (mg/100g Dw)	0.80
B_{12}(µg/100g DW)	0.8
Biotin(µg/100g DW)	170

Total Protein = N x 4.38

Experimental procedures

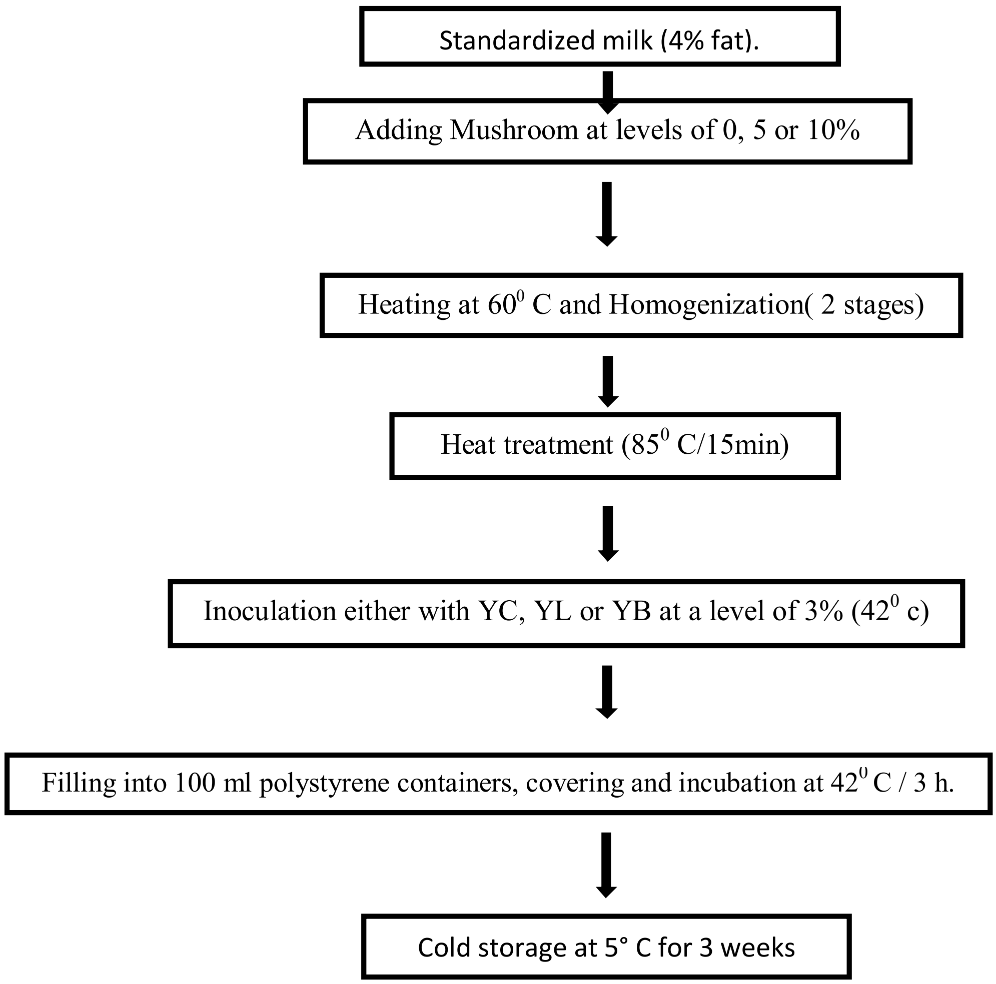
1. Preparation of bacterial starter culture

Lyophilized bacterial cultures were separately inoculated in skimmed milk which was previously autoclaved at 121°C/15 min. Then incubated at 42°C for the YC , at 37°C for the YL and YB type. The complete curdling occurred within 3 h. Starter cultures were freshly used.

2. Preparation of cooked mushroom:

Cooked mushroom was prepared by soaking the cleaned small pieces of mushroom in water (1 kg mushroom/ 200 ml water) and boiled for 10 min, then the mixture (mushroom and water) was minced and blended to get very fine paste and kept frozen until used.

3. Preparation of fermented milk (Fig.1).



Analytical methods

Dry matter, fat, total nitrogen and titratable acidity were determined according to AOAC (2007). The pH value was measured electrometrically using Lab. pH meter with a glass electrode, Hanna digital pH meter. The mineral contents were determined according to the method described by the AOAC (2007) using atomic absorption spectrometer. The amino acids contents were determined by high performance amino acids analyzer according to the method described by AOAC(2012).The viscosity of yoghurt was determined by Brookifield DV- E viscometer using spindle 5 at rpm 20 in 200 ml of yoghurt sample. The temperature was maintained at 25^{o} C and viscosity value was expressed in centipoises (cp). Fiber contents were determined as described by AOAC (2007).Total cholesterol was determinedas described by Pantulu *et al.* (1975). Carbohydrate content of all samples was calculated as described by Ceirwyn, (1995) using the following formula:

% Available carbohydrates = 100 – (%fat+%protein+% ash+%fiber +% moisture).

Microbiological analyses

The count of *Lb. delbrueckii* ssp. *bulgaricus* was enumerated using MRS agar medium as described by Gueimonde *et al*. (2003). Culture was incubated anaerobically for 2 days at 37°C.

Whilst, *Str. thermophilus, Lb. acidophilus* and *Bifidobacterium* sp.were enumerated using M17 agar, MRS-salicin agar and MRS agar media, respectively after the incubation at 37°C for 72 h. as in Dave & Shah (1996).

Organoleptic evaluation

Sensory evaluation of yoghurt samples was applied during storage period by the staff members of Dairy Chemistry Department, Animal Production Research Institute, according to Tamime and Robinson (1999) using the yoghurt evaluation scheme III approved by the American Dairy Science Association.

Nutritional value of yoghurt

Daily values of nutrients for yoghurt were calculated using food tables (FDA, 2013)

Statistical analysis

The data obtained were statistical analysed according to statistical analyses system user's guide (SAS, 1996).

RESULTS AND DISCUSSION

Gross composition of yoghurt

Data in Table (2) indicated that the supplementing with *A. bisporus* led to significant differences in the dry matter (DM) contents of the resultant yoghurt. All contents calculated on dry basis. Content of protein, ash and fiber increased while the fat decreased significantly by increasing the level of *A. bisporus*. It is worthy to mention that all DM contents are, in general, in coincidence with the Egyptian Organization for Standards and Quality (EOSQ, 2010).

Table 2. Gross composition of yoghurt as affected either by the level of Supplementing with *Agaricus bi*sporus or the type of bacterial starter culture.

Component (%)	levels of supplementing with mushroom								
	0.0 % (control)			5%			10%		
	YC	YL	YB	YC	YL	YB	YC	YL	YB
Dry matter	12.780	12.782	12.784	12.804	12.806	12.805	12.829	12.830	12.829
Fat	$3.940^{a,a}$	$3.940^{a,a}$	$3.942^{a,a}$	$3.756^{b,a}$	$3.755^{b,a}$	$3.755^{b,a}$	$3.571^{c,a}$	$3.570^{c,a}$	$3.570^{c,a}$
Protein	$3.720^{b,a}$	$3.722^{b,a}$	$3.721^{b,a}$	$3.783^{ab,a}$	$3.783^{ab,a}$	$3.784^{ab,a}$	$3.846^{a,a}$	$3.846^{a,a}$	$3.845^{a,a}$
Ash	$0.830^{b,a}$	$0.831^{b,a}$	$0.831^{b,a}$	$0.879^{ab,a}$	$0.880^{ab,a}$	$0.879^{ab,a}$	$0.928^{a,a}$	$0.927^{a,a}$	$0.928^{a,a}$
Fiber	-	-	-	$0.103^{b,a}$	$0.103^{b,a}$	$0.103^{b,a}$	$0.206^{a,a}$	$0.205^{a,a}$	$0.206^{a,a}$
Total Carbohydrates	$4.290^{a,a}$	$4.289^{a,a}$	$4.290^{a,a}$	$4.283^{a,a}$	$4.285^{a,a}$	$4.284^{a,a}$	$4.278^{a,a}$	$4.282^{a,a}$	$4.280^{a,a}$

The letters before comma possess the factor of mushroom level. While those after comma possess the factor of the starter. The means with the same letter at any position did not significantly differ (P>0.05) .

YC= Yoghurt culture, (*Str. thermophilus + Lb. bulgaricus).*

YL= Yoghurt culture + *Lactobacillus acidophilus* (1:1).

YB= Yoghurt culture + *Biifidobacterium bifidum* (1:1).

The obtained results indicated that, neither dry matter nor total carbohydrates were influenced by the type of bacterial starter culture at any level of *A. bisporus* supplementation.

Moreover, there wassignificant reductionin the fat content of yoghurt associated with the increase in supplementing level of *A. bisporus* especially at a level of 10%. The fat content of all treatments agreed with legal standards of EOSQ (2010).

With regard to the protein, ash and fiber contents of yoghurt, data illustrated in table (2) confirmed that, the protein, ash and fiber contents increased significantly ($P < 0.001$) as the supplementing level with *A. bisporus* increased. The maximum was at a level of 10%.

Regarding the total carbohydrates content of yoghurt, data given in table (2) stated that neither the kind of starter nor the level of supplementing *A. bisporus* led to any significant differences ($P > 0.05$) in the total carbohydrates content of yoghurt.

Lactic acid bacteria population of yoghurt

Bacterial counts enumerated in Tables (3 and 4) revealed that, the *Str. thermophilus* count was higher than that of *Lb. delbrueckii* ssp. *bulgaricus* or *Lb. acidophilus* or *Bifidobacterium bifidum* in all treatments. Rasic and Kurmann (1978) reviewed that *Str. thermophilus* grows faster at the beginning of lactic acid fermentation, outnumbering *Lb. delbrueckii* ssp. *bulgaricus* by 3 or 4 times often the 1st h. Moreover, the fortification with *A. bisporus* led to promote the growth of all strains of yoghurt bacterial starter cultures. This promoting action achieved their maximum when *A. bisporus* was added at level of 5%. Similar observations were reported by Chou *et al*. (2013).

During cold storage period, both counts of *Str. thermophilus* and *Lb. acidophilus* increased significantly along the first week, then decreased gradually thereafter (Tables, 3 and 4). While the count of *Lb. delbrueckii* ssp. *bulgaricus* started to decrease from the beginning of cold storage period. The count of *Bifidobacterium bifidum* still high as till the first week and began to reduce. These findings are in coincidence with those reviewed by Rasic and Kurmann (1978) who reported that, the total count of viable yoghurt bacterial ranges between 200×10^6 and 1000×10^6 cfu / ml of fresh yoghurt. During the storage of yoghurt even at 5°C, the number of lactic acid bacteria decreases reaching 1×10^6 cfu/ ml after 80 days at 5°C.

Table 3. Counts of *streptococcus thermophilus* and *Lactobacillus delbrueckii* ssp. *bulgaricus* (cfu x 10^7 / g) of yoghurt as affected either by the level of supplementing with *Agaricus bisporus* or the type of bacterial starter culture during storage period.

Cold storage period (week)	level of supplementing with mushroom								
	0.0 % (control)			5%			10%		
	YC	YL	YB	YC	YL	YB	YC	YL	YB
			streptococcus thermophilus (cfu x 10^7 / g)						
0	$540^{b,a,a}$	$250^{b,b,a}$	$245^{b,b,a}$	$580^{a,a,a}$	$247^{a,b,a}$	$247^{a,b,a}$	$540^{b,a,a}$	$244^{b,b,a}$	$240^{b,b,a}$
1	$550^{b,a,b}$	$260^{b,b,b}$	$246^{b,b,b}$	$590^{a,a,b}$	$249^{a,b,b}$	$248^{a,b,b}$	$545^{b,a,b}$	$246^{b,b,b}$	$243^{b,b,b}$
2	$390^{b,a,c}$	$234^{b,b,c}$	$230^{b,b,c}$	$420^{a,a,c}$	$236^{a,b,c}$	$234^{a,b,c}$	$380^{b,a,c}$	$232^{b,b,c}$	$230^{b,b,c}$
3	$345^{b,a,d}$	$227^{b,b,d}$	$226^{b,b,d}$	$360^{a,a,d}$	$229^{a,b,d}$	$227^{a,b,d}$	$330^{b,a,d}$	$223^{b,b,d}$	$222^{b,b,d}$
			Lactobacillus delbrueckii ssp. *bulgaricus*						
0	$170^{b,a,a}$	$82^{b,b,a}$	$80^{b,b,a}$	$190^{a,a,a}$	$87^{a,b,a}$	$81^{a,b,a}$	$170^{c,a,a}$	$79^{c,b,a}$	$60^{c,b,a}$
1	$80^{b,a,b}$	$44^{b,b,b}$	$41^{b,b,b}$	$99^{a,a,b}$	$54^{a,b,b}$	$57^{a,b,b}$	$45^{c,a,b}$	$58^{c,b,b}$	$46^{c,b,b}$
2	$45^{b,a,c}$	$5.4^{b,b,c}$	$5.1^{b,b,c}$	$58^{a,a,c}$	$5.8^{a,b,c}$	$5.3^{a,b,c}$	$28^{c,a,c}$	$4.9^{c,b,c}$	$4.8^{c,b,c}$
3	$13^{b,a,d}$	$2.8^{b,b,d}$	$2.5^{b,b,c}$	$17^{a,a,d}$	$3.1^{a,b,d}$	$2.7^{a,b,d}$	$11^{c,a,d}$	$2.8^{c,b,d}$	$1.1^{c,b,d}$

The letters before comma possess the factor of mushroom level. While those after comma possess the factor of the starter and storage period, respectively. The means with the same letter at any position were not significant (P>0.05)

The results showed that viability of probiotic of all samples decreased with storage time and the count of *Bifidobacterium bifidum* was the lowest among the probiotics after 21 d of cold storage. Similar observations were reported by Chou *et al*. (2013).

Generally, it is worthy to mention that, the bacterial counts of all yoghurt treatments, in relation either to the kind and level of supplementing or to the bacterial starter culture, whether when fresh or along cold storage period, stilled conforming the figures provided by Codex Alimentarius commission of FAO/ WHO (2002) which approved an international standard as established a minimum of 10^7/g for the starter cultures of fermented milks and a minimum of 10^6/g for specific starter bacteria for which a claim is made for specific microorganism that has been added as supplement.

Table 4. Counts of *Lactobacillus acidophilus* and *Bifidobacterium* sp. (cfu x 10^7 / g) in YL and YB yoghurt as affected by level of supplementing with *Agaricus bisporus* during storage period

Cold storage period (week)	level of supplementing with mushroom		
	0.0% (control)	5%	10%
	Lactobacillus acidophilus		
0	$46^{b,a}$	$50^{a,a}$	$46^{b,a}$
1	$47^{b,a}$	$53^{a,a}$	$45^{b,a}$
2	$23^{b,b}$	$20^{a,b}$	$19^{b,b}$
3	$3.0^{b,c}$	$3.4^{a,c}$	$2.7^{b,c}$
	Bifidobacterium bifidum		
0	$40^{b,a}$	$42^{a,a}$	$39^{b,a}$
1	$38^{b,a}$	$43^{a,a}$	$38^{b,a}$
2	$17^{b,b}$	$19^{a,b}$	$10^{b,b}$
3	$1.2^{b,c}$	$1.4^{a,c}$	$0.9^{b,c}$

The letters before comma possess the factor of mushroom level. While those after comma possess the factor of the starter and storage period, respectively. The means with the same letter at any position were not significant (P>0.05) .

Chemical and Physical properties

Titratable acidity (%) and pH value

The results of table (5) showed that, the control had the highest T.A% when fresh,whilethe treatment with *A. bisporus* at level 10% had lower value in T.A% and the pH value was higher than the treatment supplemented with *A. bisporus* at level 5%.

Moreover, the level of acidity produced by YL starter culture in yoghurt was significantly the highest (p<0.001).

Generally, the prolonging of cold storage period of yoghurt caused a significant increase (p<0.001) in T.A% and significant reduction (p<0.001) in pH value.

Table 5. Titratable acidity (TA) and pH value of yoghurt as affected either by the level of supplementing with *Agaricus bisporus* or the type of bacterial starter culture during storage period.

Cold storage period (week)	level of supplementing with mushroom								
	0.0% (control)			5%			10%		
	YC	YL	YB	YC	YL	YB	YC	YL	YB
T.A(%)									
0	$0.86^{a,b,a}$	$0.86^{a,a,a}$	$0.78^{a,c,a}$	$0.83^{b,b,a}$	$0.85^{b,a,a}$	$0.76^{b,c,a}$	$0.82^{b,b,a}$	$0.83^{b,a,a}$	$0.75^{b,c,a}$
1	$0.96^{a,b,b}$	$1.06^{a,a,b}$	$0.87^{a,c,b}$	$0.91^{b,b,b}$	$0.97^{b,a,b}$	$0.82^{b,c,b}$	$0.90^{b,b,b}$	$0.94^{b,a,b}$	$0.80^{b,c,b}$
2	$1.15^{a,b,c}$	$1.18^{a,a,c}$	$0.93^{a,c,c}$	$1.02^{b,b,c}$	$1.11^{b,a,c}$	$0.89^{b,c,c}$	$1.05^{b,b,c}$	$1.08^{b,a,c}$	$0.93^{b,c,c}$
3	$1.25^{a,b,d}$	$1.27^{a,a,d}$	$1.11^{a,c,d}$	$1.19^{b,b,d}$	$1.23^{b,a,d}$	$1.01^{b,c,d}$	$1.20^{b,b,d}$	$1.24^{b,a,d}$	$1.07^{b,c,d}$
pH									
0	$4.63^{c,b,a}$	$4.61^{c,c,a}$	$4.80^{c,a,a}$	$4.66^{b,b,a}$	$4.63^{b,c,a}$	$4.83^{b,a,a}$	$4.68^{a,b,a}$	$4.67^{a,c,a}$	$4.85^{a,a,a}$
1	$4.52^{c,b,b}$	$4.46^{c,c,b}$	$4.71^{c,a,b}$	$4.56^{b,b,b}$	$4.50^{b,c,b}$	$4.75^{b,a,b}$	$4.59^{a,b,b}$	$4.53^{a,c,b}$	$4.78^{a,a,b}$
2	$4.36^{c,b,c}$	$4.31^{c,c,c}$	$4.60^{c,a,c}$	$4.43^{b,b,c}$	$4.34^{b,c,c}$	$4.68^{b,a,c}$	$4.45^{a,b,c}$	$4.35^{a,c,c}$	$4.65^{a,a,c}$
3	$4.19^{c,b,d}$	$4.15^{c,c,d}$	$4.44^{c,a,d}$	$4.23^{b,b,d}$	$4.19^{b,c,d}$	$4.48^{b,a,d}$	$4.25^{a,b,d}$	$4.18^{a,c,d}$	$4.50^{a,a,d}$

The letters before comma possess the factor of mushroom level. While those after comma possess the factor of the starter and storage period, respectively. The means with the same letter at any position were not significanly different (P>0.05)

Amino acids content

It could be noticed from the data in table (6), that there were significant increases in the essential amino acids andnon essential amino acids content of yoghurt associated with the proportional of in the supplementing level with *A. bisporus*.

Data showed that, neither the kind of starter nor the level of supplementing with *A. bisporus* led to any significant differences (P< 0.05) in the essential amino acids andnon essential amino acids content of all yoghurt treatments.

Data in Table (6) indicated that the yoghurt fortified with levels of *A. bisporus* was good source for glutamic acid and phenyl alanine also it was rich in tryptophan, tyrosine, alanine and argenine.

Table 6. Amino acids of yoghurt as affected either by the level of supplementing with *Agaricus bisporus* or the type of bacterial starter culture.

Amino acid (g/100ml)	level of supplementing with mushroom								
	0.0 % (control)			5%			10%		
Essential Amino Acids:	YC	YL	YB	YC	YL	YB	YC	YL	YB
Isoleucine	$0.1823^{c,a}$	$0.1823^{b,a}$	$0.1823^{a,a}$	$0.1827^{c,a}$	$0.1827^{b,a}$	$0.1827^{a,a}$	$0.1831^{c,a}$	$0.1831^{b,a}$	$0.1831^{a,a}$
Leucine	$0.3177^{a,b}$	$0.3176^{b,b}$	$0.3177^{c,a}$	$0.3111^{a,b}$	$0.3111^{b,b}$	$0.3111^{c,a}$	$0.3046^{a,b}$	$0.3046^{b,b}$	$0.3046^{c,a}$
Lysine	$0.2723^{c,a}$	$0.2723^{b,a}$	$0.2723^{a,b}$	$0.2738^{c,a}$	$0.2738^{b,a}$	$0.2738^{a,b}$	$0.2754^{c,a}$	$0.2754^{b,a}$	$0.2754^{a,b}$
Tryptophan	$0.0020^{c,a}$	$0.0021^{b,a}$	$0.0021^{a,b}$	$0.2159^{c,a}$	$0.2159^{b,a}$	$0.2158^{a,,b}$	$0.4297^{c,a}$	$0.4298^{b,a}$	$0.4298^{a,b}$
Therionine	$0.1550^{a,a}$	$0.1549^{b,a}$	$0.1550^{c,a}$	$0.1542^{a,a}$	$0.1542^{b,a}$	$0.1542^{c,a}$	$0.1536^{a,a}$	$0.1536^{b,a}$	$0.1536^{c,a}$
Valine	$0.2150^{a,b}$	$0.2150^{b,b}$	$0.2150^{c,a}$	$0.2078^{a,b}$	$0.2078^{b,b}$	$0.2078^{c,a}$	$0.2006^{a,b}$	$0.2006^{b,b}$	$0.2006^{c,a}$
Methionine	$0.1488^{a,b}$	$0.1488^{b,b}$	$0.1488^{c,a}$	$0.1436^{a,b}$	$0.1436^{b,b}$	$0.1436^{c,a}$	$0.1385^{a,b}$	$0.1385^{b,b}$	$0.1385^{c,a}$
Cesteine	$0.0260^{c,a}$	$0.0261^{b,a}$	$0.0261^{a,b}$	$0.0286^{c,a}$	$0.0286^{b,a}$	$0.0286^{a,b}$	$0.0312^{c,a}$	$0.0312^{b,a}$	$0.0312^{a,b}$
Phenylalanine	$0.1607^{c,a}$	$0.1607^{b,a}$	$0.1607^{a,a}$	$0.1620^{c,a}$	$0.1620^{b,a}$	$0.1620^{a,a}$	$0.1633^{c,a}$	$0.1633^{b,a}$	$0.1633^{a,a}$
Tyrosine	$0.0949^{c,a}$	$0.0948^{b,a}$	$0.0948^{a,b}$	$0.1453^{c,a}$	$0.1453^{b,a}$	$0.1453^{a,b}$	$0.1463^{c,a}$	$0.1463^{b,a}$	$0.1463^{a,b}$
Total EAA	$1.5747^{c,a}$	$1.5746^{b,a}$	$1.5748^{a,b}$	$1.8260^{c,a}$	$1.8260^{b,a}$	$1.8259^{a,b}$	$2.0253^{c,a}$	$2.0254^{b,a}$	$2.0254^{a,b}$
Non-Essential Amino acids:									
Aspartic acid	$0.2656^{a,b}$	$0.2656^{b,b}$	$0.2656^{c,a}$	$0.2622^{a,b}$	$0.2622^{b,b}$	$0.2622^{c,a}$	$0.2588^{a,b}$	$0.2588^{b,b}$	$0.2588^{c,a}$
Glutamic acid	$0.0673^{c,a}$	$0.0673^{b,a}$	$0.0673^{a,b}$	$0.0768^{c,a}$	$0.0768^{b,a}$	$0.0768^{a,b}$	$0.0890^{c,a}$	$0.0890^{b,a}$	$0.0890^{a,b}$
Serine	$0.2009^{a,b}$	$0.2009^{b,b}$	$0.2009^{c,a}$	$0.1995^{a,b}$	$0.1995^{b,b}$	$0.1995^{c,a}$	$0.1981^{a,b}$	$0.1981^{b,b}$	$0.1981^{c,a}$
Glycine	$0.0672^{c,a}$	$0.0672^{b,a}$	$0.0672^{a,b}$	$0.0717^{c,a}$	$0.0717^{b,a}$	$0.0717^{a,b}$	$0.0790^{c,a}$	$0.0790^{b,a}$	$0.0790^{a,b}$
Argenine	$0.0967^{c,a}$	$0.0967^{b,a}$	$0.0967^{a,b}$	$0.1028^{c,a}$	$0.1028^{b,a}$	$0.1028^{a,b}$	$0.1078^{c,a}$	$0.1078^{b,a}$	$0.1078^{a,b}$
Alanine	$0.1079^{c,a}$	$0.1079^{b,a}$	$0.1079^{a,b}$	$0.1152^{c,a}$	$0.1152^{b,a}$	$0.1152^{a,b}$	$0.1225^{c,a}$	$0.1225^{b,a}$	$0.1225^{a,b}$
Proline	$0.3794^{a,b}$	$0.3795^{b,b}$	$0.3795^{c,a}$	$0.3707^{a,b}$	$0.3707^{b,b}$	$0.3707^{c,a}$	$0.3611^{a,b}$	$0.3611^{b,b}$	$0.3611^{c,a}$
Histidine	$0.0915^{a,b}$	$0.0914^{b,b}$	$0.0914^{c,a}$	$0.0898^{a,b}$	$0.0898^{b,b}$	$0.0898^{c,a}$	$0.0881^{a,b}$	$0.0881^{b,b}$	$0.0881^{c,a}$
Total non EAA	$1.2765^{c,a}$	$1.2765^{b,a}$	$1.2765^{a,b}$	$1.2937^{c,a}$	$1.2937^{b,a}$	$1.2937^{a,b}$	$1.3044^{c,a}$	$1.3044^{b,a}$	$1.3044^{a,b}$
Total A.A	$2.8512^{c,a}$	$2.8511^{b,a}$	$2.8513^{a,b}$	$3.1197^{c,a}$	$3.1197^{b,a}$	$3.1196^{a,b}$	$3.3297^{c,a}$	$3.3298^{b,a}$	$3.3298^{a,b}$

The letters before comma possess the factor of mushroom level. While those after comma possess the factor of the starter. The means with the same letter at any position were not significant (P>0.05)

Minerals and Vitamins contents

Regarding the minerals and vitamins contents of yoghurt, data given in table (7) stated that neither the kind of starter nor the level of supplementing *A. bisporus* led to any significant differences (P> 0.05) in the minerals and vitamins contents of yoghurt.

Data presented in table (7) showed that adding *A. bisporus* caused significant (P<0.005) decrease in calcium and sodium ofyoghurt fortified with levels of *A. bisporus* comparing with the control, whilemagneium, potassium, iron, phosphorus, manganese and copper were significantly higher than the control as reported by. Verma *et al.,(* 1987).

Regarding the zinc content of yoghurt, data given in table (7) showed no significant differences in all treatments as affected by the level supplementing or the bacterial culture.

Also the addition of *A. bisporus* led to increase vitamins content (riboflavin, niacin, B12, biotin, folate and thiamin).While the kind of starter culture had no significant differences.

Furthermore, the yoghurt fortified with levels of *A. bisporus* was rich in biotin, folate and niacin comparing with the control(0.0 %) .

Cholesterol Content:

It was clear from Table (8) which revealed significant variations between the two levels of supplementing *A. bisporus* and the starter culture during the storage period. The cultures YC,YL and YB were able to assimilate cholesterol during storage, but the reduction of cholesterol in the treatments inculated with YL culture was the highest comparing with YC and YB cultures throughout the storage period. Types of fermented milk the level of supplementing *A. bisporus* had the highest percent of cholesterol reduction compared to standardized buffalo's milk (4% fat). This could be due to that *A. bisporus*is an ideal food for the dietetic prevention of atherosclerosis due to their high fiber and low fat content. The edible mushrooms in a natural hypocholesterolemic and antisclerotic diet is often prescribed in Oriental medicine (Sun *et al.,* 1984).

Table 7. Minerals and Vitamins contents of yoghurt as affected either by the level of supplementing with *Agaricus bisporus* or the type of bacterial starter culture (mg/ 100g yoghurt).

Minerals (mg)	level of supplementing with mushroom								
	0.0% (control)			5%			10%		
	YC	YL	YB	YC	YL	YB	YC	YL	YB
Mg	$15^{c,b}$	$15.1^{c,a}$	$15.0^{c,a}$	$15.337^{b,b}$	$15.338^{b,a}$	$15.338^{b,a}$	$15.676^{a,a}$	$15.676^{a,a}$	$15.675^{a,b}$
Na	$51.0^{a,b}$	$51.0^{a,b}$	$51.02^{a,a}$	$48.523^{b,b}$	$48.533^{b,b}$	$48.527^{b,a}$	$46.046^{c,b}$	$46.048^{c,b}$	$46.046^{c,a}$
K	$116^{c,a}$	$116.2^{c,a}$	$116.11^{c,b}$	$132.905^{b,a}$	$132.906^{b,a}$	$132.905^{b,b}$	$149.81^{a,a}$	$149.81^{a,a}$	$149.80^{a,b}$
Fe	$0.30^{c,ba}$	$0.32^{c,a}$	$0.31^{c,b}$	$0.3539^{b,ba}$	$0.3538^{b,a}$	$0.3539^{b,b}$	$0.4078^{a,ba}$	$0.4079^{a,a}$	$0.4078^{a,b}$
Ca	$195.0^{a,c}$	$195.1^{a,b}$	$195.0^{a,a}$	$185.404^{b,c}$	$185.500^{b,b}$	$185.405^{b,a}$	$175.806^{c,c}$	$175.901^{c,b}$	$175.809^{c,a}$
Zn	$0.700^{a,a}$	$0.701^{a,a}$	$0.700^{a,a}$	$0.706^{a,a}$	$0.708^{a,a}$	$0.707^{a,a}$	$0.712^{a,a}$	$0.712^{a,a}$	$0.713^{a,a}$
P	$191.00^{c,a}$	$191.10^{c,a}$	$191.00^{c,b}$	$236.80^{b,a}$	$236.70^{b,a}$	$236.70^{b,b}$	$282.60^{a,a}$	$282.63^{a,a}$	$282.63^{a,b}$
Cu	-	-	-	$0.0190^{b,a}$	$0.0190^{b,a}$	$0.0190^{b,b}$	$0.0381^{a,a}$	$0.0382^{a,a}$	$0.0382^{a,b}$
Mn	-	-	-	$0.0128^{b,a}$	$0.0128^{b,a}$	$0.0128^{b,b}$	$0.0256^{a,a}$	$0.0257^{a,a}$	$0.0256^{a,b}$
Vitamins (mg)									
Riboflavin(B)	$0.1100^{c,a}$	$0.1101^{c,a}$	$0.1100^{c,a}$	$0.3346^{b,a}$	$0.3345^{b,b}$	$0.3345^{b,b}$	$0.5590^{a,b}$	$0.5590^{a,b}$	$0.5591^{a,a}$
Niacin	$0.1700^{c,a}$	$0.1700^{c,a}$	$0.1700^{c,a}$	$2.8615^{b,a}$	$2.8615^{b,a}$	$2.8615^{b,a}$	$5.5530^{a,a}$	$5.5530^{a,a}$	$5.5530^{a,a}$
B_{12}(µg)	$0.4001^{c,a}$	$0.4002^{b,a}$	$0.4002^{a,b}$	$0.4200^{c,a}$	$0.4201^{b,a}$	$0.4201^{a,b}$	$0.4400^{c,a}$	$0.4400^{b,a}$	$0.4400^{a,b}$
Biotin	$0.0170^{c,b}$	$0.0171^{c,a}$	$0.0171^{c,a}$	$8.5123^{b,a}$	$8.5123^{b,a}$	$8.5123^{b,a}$	$17.0117^{a,a}$	$17.0117^{a,a}$	$17.0117^{a,a}$
Folate(µg)	$0.6001^{c,a}$	$0.6000^{c,b}$	$0.6000^{c,b}$	$36.5700^{b,a}$	$36.5700^{b,a}$	$36.5700^{b.a}$	$72.5400^{a,a}$	$72.5400^{a,a}$	$72.5400^{a,a}$
Thiamin(B_1)	$0.0500^{c,b}$	$0.0501^{c,a}$	$0.0501^{c,a}$	$0.0875^{b,a}$	$0.0875^{b,a}$	$0.0875^{b,a}$	$0.1250^{a,a}$	$0.1250^{a,a}$	$0.12500^{a,a}$

The letters before comma possess the factor of mushroom level. While those after comma possess the factor of the starter. The means with the same letter at any position were not significantly different($P>0.05$)

Rheological analysis

Regarding curd tension for all yoghurt treatments with different levels of *A. bisporus* (during storage periods),it was noticed that *A. bisporus* adding with different levels had an effect on the curd tension (fig 2). The highest curd tension values were obtained in fortified yoghurt with *A. bisporus* (10%), followed by *A. bisporus* (5%) and *A. bisporus* (0.0%).

Data illustrated too in fig.(2) showed that the different kinds used of bacterial starter cultures affected the curd tentionat the beginning and the end of cold storage period.Yoghurt with YL starter had the highest curd tension.

Generally It is obviously clear that synercis and curd tension of yoghurt were significantly affected by fortification with different levels of *A. bisporus* and different types of biological starter cultures. That was occurred during storage periods of yoghurt, also the curd tension significantly increased with increasing thestorage period.

The viscosity values of functional yoghurt fortified with levels of *A. bisporus* and used different kinds of biological starter cultures were stated and illustrated in Fig (3). The data indicated that the treatment of YC and10% *A. bisporus* had higher viscosity value than that in treatments fortified with 5% *A. bisporus*or control. For example the viscosity value was 410,411 and 408 cp for YC,YL and YC,YL and YB control treatments while were 529, 530, 528 in treatments with 5% of *A. bisporus* in order. The corresponding values in treatments with 10% *A. bisporus* were 691,693 and 690 cp in same order. The obtained data also indicated that the viscosity was highier in treatments with YL than others (YC,YB). That could be due to that DF had desirable functional properties, such as providing texture, gelling, thickening, emulsification, and stabilization in DF-enriched foods (Nelson, 2001).

Therefore, DF research, particularly in the growing nutraceutical industry, has gained a lot of attention recently (Jalili *et al.,* 2000).The results also showed that increasing the ratio added of *A. bisporus* caused significant increase in viscosity. That increasing was significant with increasing the storage period.

Furthermore, the rheological parameters of all yoghurt treatments raised as a function of cold storage period for 3 weeks. That might be due to the acidity developed as the cold storage period prolonged. Those observations agreed with those reported by Husein *et al*. (2006).

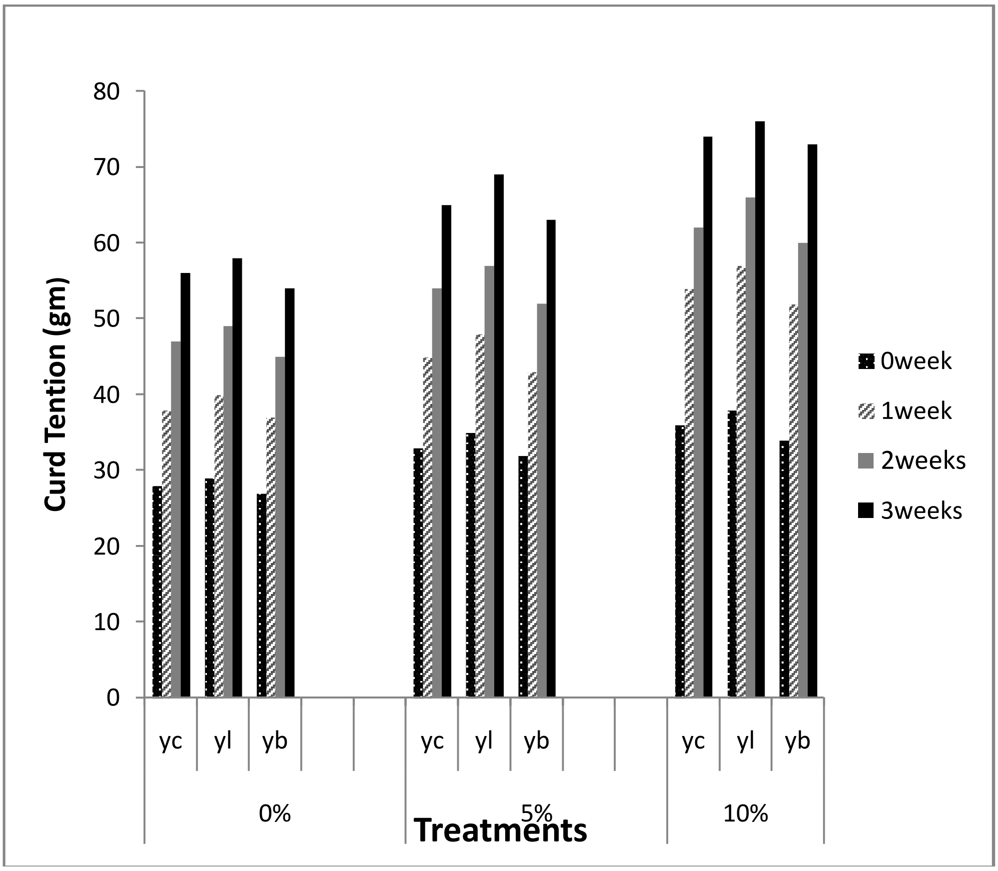


Fig. 2. curd tension (gm) of yoghurt as affected either by the level of supplementing *Agaricus bisporus* or the type of bacterial starter culture.

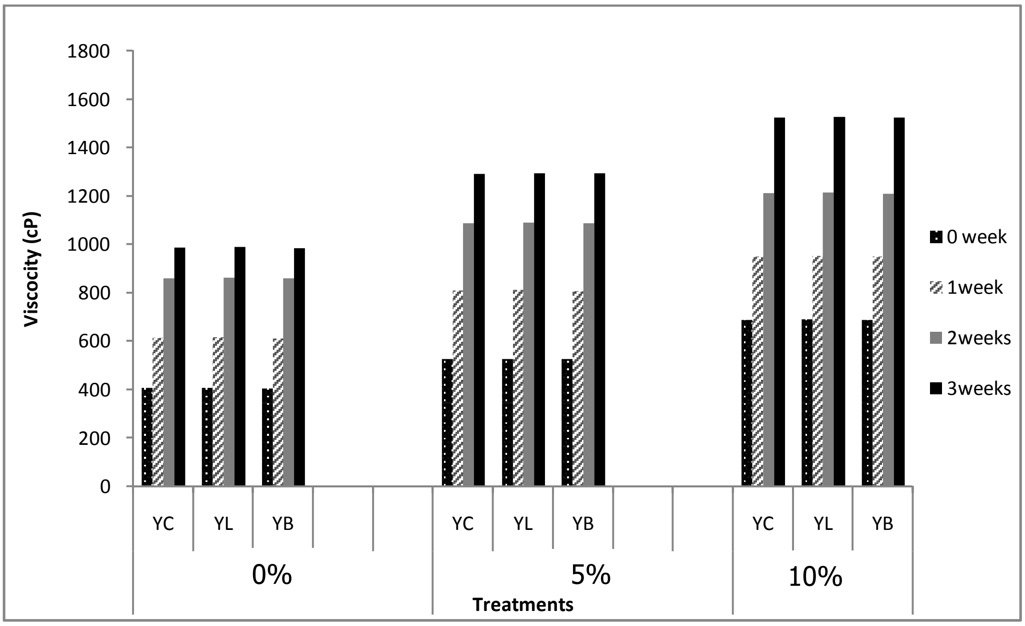


Fig. 3. Viscosity (cp) of yoghurt as affected either by the level of supplementing mushroom or the type of bacterial starter culture.

Table 8. Cholesterol content (mg/100g) of yoghurt as affected either by the level of supplementing with *Agaricus bisporus* or the type of bacterial starter culture during storage period.

Cold storage period (week)	level of supplementing with mushroom																	
	0%						5%						10%					
	YC		YL		YB		YC		YL		YB		YC		YL		YB	
	T.C*	Red.*	T.C*	Red.*	T.C*	Red.*	T.C*	Red.*	T.C*	Red.*	T.C*	Red.*	T.C*	Red.*	T.C*	Red.*	T.C*	Red.*
0	17.21^{a,b,d}	22.19^{c,c,c}	16.35$^{b,c.d}$	26.08^{b,a,cc}	16.78^{c,a,d}	24.14^{a,b,c}	15.52^{a,b,d}	29.83^{c,c,c}	14.45^{b,c,d}	34.67^{b,a,c}	15.01^{c,a,d}	32.14^{a,b,c}	13.70^{,b,d}	37.92^{c,c,c}	12.37^{b,c,d}	44.07^{b,a,c}	13.05^{c,a,d}	41.00^{a,b,c}
1	16.85^{a,b,a}	23.82$^{c.c,b}$	15.90^{b,c,a}	28.11^{b,a,b}	16.36^{c,a,a}	26.03^{a,b,b}	15.22^{a,b,a}	31.19^{c,c,b}	14.19^{b,c,a}	35.84^{b,a,b}	14.76^{c,a,a}	33.27^{a,b,b}	13.45^{a,b,a}	39.19^{c,c,b}	12.24^{b,c,a}	44.66^{b,a,b}	12.90^{c,a,a}	41.68^{a,b,b}
2	16.67^{a,b,b}	24.63^{c,c,b}	15.72^{b,c,b}	28.93^{b,a,b}	16.14^{c,a,b}	27.03^{a,b,b}	15.04^{a,b,b}	32.00^{c,c,b}	14.00^{b,c,b}	36.70^{b,a,b}	14.47^{c,a,b}	34.58^{a,b,b}	13.34^{a,b,b}	39.69^{c,c,b}	12.15^{b,c,b}	45.07^{b,a,b}	12.75^{c,a,b}	42.35^{a,b,b}
3	16.63^{a,b,c}	25.27^{c,c,a}	15.54$^{b.c,c}$	29.74^{b,a,a}	15.98^{c,a,c}	27.75^{a,b,a}	14.95^{a,b,c}	32.41^{c,c,a}	13.85^{b,c,c}	37.38^{b,a,a}	14.28^{c,a,c}	35.44^{a,b,a}	13.21^{a,b,c}	40.28^{c,c,a}	12.05^{b,c,c}	45.52^{b,a,a}	12.55^{c,a,c}	43.26^{a,b,a}

*T.C: Total cholesterol. Mg/100g yoghurt

*Red: Reduction cholesterol. %

The letters before comma possess the factor of mushroom level. While those after comma possess the factor of the starter and storage period, respectively. The means with the same letter at any position were not significantly different (P>0.05)

Sensory evaluation

Table (9) showed the judging scores and its statistical analysis of yoghurt during cold storage period as affected either by the level of supplementing with *A. bisporus* and/or the type of bacterial starter culture used. Regarding the appearance score, body and texture, given in Table (9) exhibited no differences among all yoghurt treatments whether fortified with *A. bisporus* or not (the control) and/or culture with YC, YL and YB as well as when fresh or along cold storage period.

Table 9. Organoleptic score of yoghurt as affected either by the level of supplementing with *Agaricus bisporus* or the type of bacterial starter culture during storage period.

Cold storage period (week)	level of supplementing mushroom								
	0.0%(control)			5%			10%		
	YC	YL	YB	YC	YL	YB	YC	YL	YB
Appearance score (5 points)									
0	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$
1	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$
2	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$4^{a,a,a}$	$4^{a,a,a}$	$4^{a,a,a}$
3	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$4^{a,a,a}$	$4^{a,a,a}$	$4^{a,a,a}$
Body and texture score (5 points)									
0	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$
1	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$
2	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$
3	$4^{a,a,a}$	$4^{a,a,a}$	$4^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$	$5^{a,a,a}$
Flavor score (10 points)									
0	$10^{a,a,a}$	$10^{a,a,a}$	$10^{a,a,a}$	$10^{a,a,a}$	$10^{a,a,a}$	$10^{a,a,a}$	$9^{b,a,a}$	$9^{b,a,a}$	$9^{b,a,a}$
1	$9^{a,a,a}$	$9^{a,a,a}$	$10^{a,a,a}$	$10^{a,a,a}$	$10^{a,a,a}$	$10^{a,a,a}$	$9^{b,a,a}$	$9^{b,a,a}$	$9^{b,a,a}$
2	$8^{a,a,b}$	$8^{a,a,b}$	$9^{a,a,b}$	$9^{a,a,b}$	$9^{a,a,b}$	$10^{a,a,b}$	$8^{b,a,b}$	$8^{b,a,b}$	$9^{b,a,b}$
3	$8^{a,a,b}$	$8^{a,a,b}$	$9^{a,a,b}$	$9^{a,a,b}$	$8^{a,a,b}$	$9^{a,a,b}$	$7^{b,a,b}$	$7^{b,a,b}$	$7^{b,a,b}$
Total score (20 points)									
0	$20^{b,b,a}$	$20^{b,b,a}$	$20^{b,a,a}$	$20^{a,b,a}$	$20^{a,b,a}$	$20^{a,a,a}$	$19^{c,b,a}$	$19^{c,b,a}$	$19^{c,a,a}$
1	$19^{b,b,a}$	$19^{b,b,a}$	$20^{b,a,a}$	$20^{a,b,a}$	$20^{a,b,a}$	$20^{a,a,a}$	$19^{c,b,a}$	$19^{c,b,a}$	$19^{c,a,a}$
2	$18^{b,b,b}$	$18^{b,b,b}$	$19^{b,a,b}$	$19^{a,b,b}$	$19^{a,b,b}$	$20^{a,a,b}$	$17^{c,b,b}$	$17^{c,b,b}$	$18^{c,a,b}$
3	$17^{b,b,c}$	$17^{b,b,c}$	$18^{b,a,c}$	$19^{a,b,c}$	$18^{a,b,c}$	$19^{a,a,c}$	$16^{c,b,c}$	$16^{c,b,c}$	$16^{c,a,c}$

The letters before comma possess the factor of mushroom level. While those after comma possess the factor of the starter and storage period, respectively. The means with the same letter at any position were not significantly different (P>0.05)

Concerning the flavor score, the fortification with *A. bisporus* (5%) was significantly higher than those of *A. bisporus* (10%), regardless the kind of the starter. Nevertheless the control samples gained flavor scores higher than those yoghurt supplemented with *A. bisporus* at level 10% and the flavor scores of yoghurt was not significant influenced by the kind of starter. Moreover, with prolonging the cold storage period of yoghurt, the flavor score tended significantly to decrease ($p<0.001$).

The total score of yoghurt which reflected the overall organoleptic quality of the product reveal that, the supplementation with *A. bisporus* at the level of (5%) led to improve the total score versus the control.

Concerning the type of bacterial starter culture, the statistical analysis confirmed that the YB yoghurt gained significantly the highest total score compared with those made by using YC or YL starter culture.

Nevertheless, significant reduction in the total score was observed when the cold storage period exceeded more than one week. All samples were organoleptically accepted.

Nutritional and daily values

As could be noticed from the data in table (10), there were significant decreses in the energy of yoghurt associated with the proportional increase in the supplementing level with *A. bisporus*, regardless the kind of starter. Regarding the daily values% of the protein, total fat and total carbohydrate, data showed that, neither the kind of starter nor the level of supplementing with *A. bisporus* led to any significant differences ($P> 0.05$) in the daily values% of the protein, total fat and total carbohydrates content of yoghurt.

Daily values (%) of cholesterol decreased significantly as the supplementing level with *A. bisporus* increased. Because the high fiber contents in *A. bisporus,* caused significant increase in daily values% of fiber.

Data presented in table (10) showed that adding *A. bisporus* caused significant decrease in the daily values% of calcium and sodium comparing with the control, but magnesium, potassium, iron, zinc, phosphorus, manganese and copper was significantly higher than the control especially, the daily values% of manganese and copper.

As appeared from table (10) the addition of *A. bisporus* led to increase all the daily values% of vitamins content measured riboflavin, niacin, B12,biotin,folate and thiamin. While the kind of starter culture did not give any significant differences in the daily values%.

Table 10. Daily values (DV%) of nutrients in yoghurt as affected either by the level of supplementing with *Agaricus bisporus* or the type of bacterial starter culture.

		level of supplementing with mushroom								
	Units count	0.0% (control)			5%			10%		
		YC	YL	YB	YC	YL	YB	YC	YL	YB
Nutrients:										
Energy	Kcal	67.50^{a,a}	67.504^{a,a}	67.522^{a,a}	66.068^{b,a}	66.067^{b,a}	66.067^{b,a}	64.635^{c,a}	64.642^{c,a}	64.630^{c,a}
Protein	G	7.444^{a,a}	7.444^{a,a}	7.442^{a,a}	7.566^{a,a}	7.566^{a,a}	7.568^{a,a}	7.692^{a,a}	7.692^{a,a}	7.690^{a,a}
Total Fat	G	6.061^{a,a}	6.060^{a,a}	6.064^{a,a}	5.778^{b,a}	5.776^{b,a}	5.776^{b,a}	5.493^{b,a}	5.492^{b,a}	5.492^{b,a}
Cholesterol	mg	5.736^{a,a}	5.45^{a,a}	5.593^{a,a}	5.173^{ab,a}	4.816^{ab,a}	5.00^{ab,a}	4.576^{b,a}	4.123^{b,a}	4.35^{b,a}
Total carbohydrate	G	1.430^{a,a}	1.429^{a,a}	1.430^{a,a}	1.427^{a,a}	1.428^{a,a}	1.428^{a,a}	1.426^{a,a}	1.427^{a,a}	1.426^{a,a}
Fiber		-	-	-	0.412^{b,a}	0.412^{b,a}	0.412^{b,a}	0.824^{a,a}	0.820^{a,a}	0.824^{a,a}
Minerals										
Mg	mg	3.750^{b,a}	3.775^{b,a}	3.750^{b,a}	3.834^{ab,a}	3.834^{ab,a}	3.834^{ab,a}	3.919^{a,a}	3.919^{a,a}	3.918^{a,a}
Na	mg	2.125^{a,a}	2.125^{a,a}	2.125^{a,a}	2.021^{b,a}	2.022^{b,a}	2.021^{b,a}	1.918	1.918	1.918
K	mg	3.314^{c,a}	3.320^{c,a}	3.170^{c,a}	3.797^{b,a}	3.797^{b,a}	3.797^{b,a}	4.280^{a,a}	4.280^{a,a}	4.280^{a,a}
Fe	mg	1.666^{c,b}	1.777^{c,a}	1.720^{c,a}	1.966^{b,a}	1.965^{b,a}	1.966^{b,a}	2.265^{a,a}	2.266^{a,a}	2.265^{a,a}
Ca	mg	19.50	19.51	19.50	18.54^{b,a}	18.55^{b,a}	18.54^{b,a}	17.58^{c,a}	17.59^{c,a}	17.58^{c,a}
Zn	mg	4.666^{a,a}	4.733^{a,a}	4.666^{a,a}	4.706^{a,a}	4.720^{a,a}	4.710^{a,a}	4.746^{a,a}	4.746^{a,a}	4.730^{a,b}
P	mg	19.10^{c,a}	19.11^{c,a}	19.10^{c,a}	23.68^{b,a}	23.67^{b,a}	23.67^{b,a}	28.260^{a,a}	28.263^{a,a}	28.263^{a,a}
Cu	mg	-	-	-	o.95^{b,a}	0.95^{b,a}	0.95^{b,a}	1.905^{a,a}	1.910^{a,a}	1.910^{a,a}
Mn	mg	-	-	-	0.64^{b,a}	0.64^{b,a}	0.64^{b,a}	1.280^{a,a}	1.285^{a,a}	1.280^{a,a}
Vitamins (mg)										
Riboflavin	mg	6.47^{c,a}	6.47^{c,a}	6.47^{c,a}	19.682^{b,a}	19.676^{b,a}	19.676^{b,a}	32.882^{a,a}	32.882^{a,a}	32.888^{a,a}
Niacin	mg	0.85^{c,a}	0.85^{c,a}	0.85^{c,a}	14.30^{b,a}	14.30^{b,a}	14.30^{b,a}	27.765^{a,a}	27.765^{a,a}	27.765^{a,a}
B_{12}(µg)	µg	6.668^{b,a}	6.67^{b,a}	6.67^{b,a}	7.00^{ab,a}	7.00^{ab,a}	7.00^{ab,a}	7.33^{a,a}	7.33^{a,a}	7.33^{a,a}
Biotin	mg	0.0056^{c,a}	0.0056	0.0056	2.837^{b,a}	2.837^{b,a}	2.837^{b,a}	5.67^{a,a}	5.67^{a,a}	5.67^{a,a}
Folate(µg)	µg	0.15^{c,a}	0.15^{c,a}	0.15^{c,a}	9.14^{b,a}	9.14^{b,a}	9.14^{b,a}	18.13^{a,a}	18.13^{a,a}	18.13^{a,a}
Thiamin(B_1)	mg	3.33^{c,a}	3.33^{c,a}	3.33^{c,a}	5.83^{b,a}	5.83^{b,a}	5.83^{b,a}	8.33^{a,a}	8.33^{a,a}	8.33^{a,a}

The letters before comma possess the factor of mushroom level. While those after comma possess the factor of the starter. The means with the same letter at any position were not significantly different (P>0.05)

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دراسة عن الزبادى المدعم بالمشروم

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استهدف البحث دراسة تدعيم الزبادى بالمشروم ذو القيمة الغذائية والصحية. حيث تم تدعيم لبن الزبادى بالمشروم بنسب صفر، 5% و10% والمعاملة الحرارية على درجة حرارة 85^0م لمدة 15 دقيقة ثم ضبط درجة الحرارة على 42°م والتلقيح بنسبة 3% بمزرعة بكتريا البادئ كل من YCوالمحتوية على *Streptococcus themophilus*،*Lactobacillus delbrueckii ssp. bulgaricus,* ، YL المحتوية على *Streptococcus themophilus, Lactobacillus delbrueckii, ssp. bulgaricus* ،*Lb. acidophilus* وYB المحتوية على *Streptococcus themophilus, Lactobacillus delbrueckii ssp. bulgaricus,* و*Bifidobacterium bifidum* و التحضين على درجة حرارة 42^0م حتى تمام التجبن (3 ساعات) وحفظ المنتج عاى درجة حرارة الثلاجة (5 ± 1^0م) لمدة 3 أسابيع واجريت الاختبارات الكيميائية ،الميكروبية ،الريولوجية والحسية بالاضافة الى تقدير القيمة الغذائية.

وقد أظهرت النتائج المتحصل عليها ان الزبادى المدعم بالمشروم قد تميز بقيم عالية فى البروتين، الرماد، الالياف، الـــpH، اللزوجة ،الاحماض الامينية، الفيتامينات، الاملاح المعدنية، الخواص الحسية ،والقيمة الغذائية وكذلك ارتفاع العدد الكلىوالـــ *Streptococcus themophilus* و*Lactobacillus delbrueckii ssp. bulgaricus,* و*Lb. acidophilus* و *Bifidobacterium bifidum* وانخفاض فى الدهن، الكوليسترول ،الحموضة ،الكالسيوم والصوديوم وقد أدت نسبة الاضافة 10% والتخزين بالثلاجة لمدة 3 أسابيع لكل العينات أدى لزيادة فى قيم الحموضة واللزوجة وتماسك الخثرة.

ومن النتائج السابقة يمكن أستنتاج ان الزبادى بجانب كونه منتج غذائى حيوى فأنه يمكن زيادة فوائده الصحية وقيمته الغذائية وخواصه الوظيفية بتدعيمه بالمشروم حتى نسبة 10% أما من الناحية البكتريولوجية والريولوجية والحسية فان التدعيم بنسبة 5% يكون أفضل.