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Impact of Maltodextrin and Inulin on Synbiotic Fermented Milk Production

Reda M El-Komaily*, Osama I El-Batawy, Ihab E Aumara
Food Sciences Dept, Fac of Agric, Ain Shams Univ, P.O. Box 68, Hadayek Shoubra 11241, Cairo, Egypt

*Corresponding author: Reda_Mohamed@agr.asu.edu.eg

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Abstract: The influence of maltodextrin or inulin added as a prebiotic on the survival of various strains of probiotics in synbiotic fermented milk along cold storage was investigated. Synbiotic fermented milk was prepared using several probiotic strains (*Lb. helveticus* and *Lb. acidophilus*) and 2% maltodextrin or inulin and compared with traditional yoghurt starters (*Lb. delbrueckii* subsp. *bulgaricus* and *Str. thermophilus*). Synbiotic fermented milk samples were stocked at 4°C then the chemical, microbiological and sensory characteristics were estimated. Starter culture strains showed no significant effect on dry matter and ash contents in various synbiotic fermented milk samples during storage. However, starter culture type, fortification by maltodextrin or inulin, and storage period significantly influenced the acidity, total and soluble nitrogen contents (SN\TN), acetaldehyde, diacetyl contents and viscosity in various synbiotic fermented milk samples. In addition, fortification of maltodextrin or inulin significantly influenced the survival of yoghurt starter culture strains, *Lb. helveticus* and *Lb. acidophilus* strains. The counts of probiotic strains used in all treatments of synbiotic fermented milk survived well and were above the recommended minimum levels (10^6CFU/ mL) during a storage period.

1 Introduction

Certain dairy products have been linked to potential health advantages for many years; fermented milk is a typical example. Functional fermented milk with probiotic bacteria has become the notable representative of this new category of food (Thorning et al 2016). Fermented milk and yoghurt products are significant sources for transporting useful bacteria strains for the human gastrointestinal tract (Itsaranuwat et al 2003). Thus, dairy products contain significant bacteria, such as lactobacilli and Bifidobacterium, used in many parts of the world as a probiotic complement (Abd El-Salam et al 2019). The human gastrointestinal tract benefits provided by probiotic strains have been mentioned, and they include safeguarding against gastrointestinal infections; reconfiguring the balanced intestinal microflora; immune system stimulation; reducing lactose intolerance; suppression of allergic interactions in food hypersensitivity; cholesterol reduction; safeguarding against cancers (Heyman 2000, Buttris 1997). The definition of a probiotic is "microorganisms that when given in sufficient quantities grant a health benefit to the host" (Cremon et al 2018). The principal potential health benefits attributed to probiotic lactic acid bacteria can be categorized as functional, nutritional, and healthy effects that can enhance therapeutic or nutraceutical fermented products (Rašić et al 1992). Further probability at microflora administration is to use synbiotic, which combines probiotic and prebiotic. Prebiotics are non-digestible food components, such as carbohydrates, certain peptides, and proteins found in milk and certain resistant lipids (Gibson and Roberfroid 1995). Synbiotics are products in which probiotics and prebiotics are incorporated into a single product. It is defined as a mixture of probiotics and prebiotics that usefully affect the host by enhancing probiotics viability and growth in the digestive system (Gibson and Roberfroid 1995).

Fermented dairy products, such as yoghurt have proven health benefits out of their context of lactic acid bacteria (Burgos et al 2020). Research should improve these health benefits through fortification with microbial culture strains or bioactive peptides phytochemicals that increase the functionality of yoghurt (Patrignani et al 2020, Abd El-Fattah et al 2018, Fazilah et al 2018). A probiotic lactic acid bacterial strain like *Lb. acidophilus* has been integrated into yoghurt cultures because of its bile-resistant characteristics and beneficial health impacts. Output products, named "bio-yoghurt product", "probiotic" or "yogurt-like" is becoming common because of the excellent health impacts of probiotics bacteria (Yilmaz-Ersan and Kurdal 2014)

Consumers search for different yoghurts with known organoleptic characteristics available in yoghurt. However, milk can produce products with weak physicochemical and organoleptic characteristics. Many researchers have attempted to enhance yoghurts functional and textural characteristics by using prebiotics. Staffolo et al (2004), observed that the yoghurt fortified with inulin had a constant color, syneresis, and water activity did not reign along with storage, analogous to other yoghurts containing dietary fibers.

Therefore, the present study aimed to produce a new type of synbiotic fermented milk produced with yoghurt starter cultures and other various probiotic strains containing maltodextrin or inulin to enhance the functional and subsequently the nutritional values of these products.

2 Materials and Methods

2.1 Ingredients

Fresh cow's milk was obtained from dairy cows (Faculty of Agriculture, Ain Shams University, Egypt). Inulin (extract from dahlia tubers) was obtained from Fluka Analytic Co (Sigma, Rides + r. 2, D-89555 S + einhe in, USA). Skim milk powder (97% DM) manufactured in Poland was collected from Cairo's local markets. Maltodextrin (a spray-dried product collected by enzymatic transformation from corn starches) has been collected from National firm to corn products, 10th of Ramadan City, Governorate of El-Sharkia Egypt.

2.2 Starter cultures

Freeze-dried yoghurt starter cultures (YC-381) comprising *Lb. delbrueckii* subsp. *bulgaricus* and *Str. thermophilus* were purchased from Chr. Hansen's Laboratories, Denmark. Yoghurt starter cultures were prepared as mother cultures by adding 1% lyophilized cell cultures to 12% sterilized reconstituted skim milk and incubated for 4–6 hour at 42°C prior to 24 hours before use.

Probiotics strains (*Lb. helveticus* 501699 and *Lb. acidophilus* 100021) supplied by Quality Medical Sciences Co. Ltd have been utilized in this study. Each strain was propagated in a specific medium deMan, Rogosa, and Sharpe (MRS) broth for 24 hour at 37°C. LAB mother cultures has been prepared and propagated by the addition of 1% of the stored cultures in 12% sterilized reconstituted skim milk and incubated for 37°C for 8 hour prior to 24 hours before use.

2.3 Production of different synbiotic fermented milk samples

Standardized fresh cow's milk (3% fat and 12% TS) was split into nine fractions, and every fraction was heat processed for 10 min at 90 °C and subsequently refrigerated at 42 °C. The nine fractions of heat-processed milk were inoculated with various starter cultures to produce various synbiotic fermented milk:

– Control, T1, and T2: fermented milk treatments made with standardized heat-treated cow's milk inoculated with 2% yoghurt starter culture and supported with 2% of skim milk powder, inulin, and maltodextrin, respectively.

– T3, T4, and T5 fermented milk treatments made with standardized heat-treated cow's milk inoculated with 2% *Lb. helveticus* and supported with 2% of skim milk powder, inulin, and maltodextrin, respectively.

– T6, T7, and T8 fermented milk treatments made with standardized heat-treated cow milk inoculated with 2% *Lb. acidophilus* and supported with 2% of skim milk powder, inulin, and maltodextrin, respectively.

All fermented milk treatments were fermented at 42°C until clotting (pH 4.7) and rapidly refrigerated to 4°C. Three replicates were done for each treatment. The resultant synbiotic fermented milk was kept for 21 days at 4°C. Three replicates of the sample were obtained and analyzed for chemical, microbiological, rheological and, organoleptic analysis when fresh and after 7, 14, and 21 days of cold storage.

2.4 Chemical composition

Ash, dry matter, titratable acidity (TA) as lactic acid and, SN/TN were measured in synbiotic fermented milk samples as clarified in (Baur and Ensminger 1977). Acetaldehyde and diacetyl contents were defined according to Xanthopoulos et al (1994) and Lees and Jago (1970) as yoghurts samples utilizing the Conway micro-diffusion semi-carbazide way.

2.5 Apparent viscosity for rheological analysis

The apparent viscosity of various fermented milk samples was measured utilizing a coaxial rotational viscometer (RHEOTEST II-Medingen, Germany) at cut rates range of 1.0 sec^{-1} into 437.4 sec^{-1} (Toledo 2007). Measuring apparatuses (S2) were used, and the samples were modified into 20 ± 1 prior to upload in the viscometer apparatus. The apparent viscosity (cp) from various samples was enumerated at the share rate from145.8s^{-1}.

2.6 Microbiological examination

Lactobacillus helveticus was enumerated on MRS agar (Tharmaraj and Shah 2003). The plates were anaerobically brooded for 48–72 h at 37°C. *LB. bulgaricus* counts were enumerated using lactobacilli MRS agar (pH 5.2) (Tharmaraj and Shah 2003). The plates were incubated anaerobically for 72 hrs at 43°C. *Lb. acidophilus* was counted by using MRS agar (Vinderola and Reinheimer 1999). The plates were incubated aerobically for 48 hours at 37°C. *Str. thermophilus* was counted on the M17 agar medium (Terzaghi and Sandine 1975). The plates were incubated aerobically for 48 hours at 37°C. Coliform counts were determined on Violet Red Bile Agar medium as reported by (Laird et al 2004). The plates were incubated for 48 hrs at 37 °C. Also, Yeast and Mold were counted on malt-extract agar medium as suggested by (Laird et al 2004). The plates were incubated for 4 days at 25 °C –27 °C.

2.7 Organoleptic evaluation

The organoleptic properties of various synbiotic fermented milk samples were evaluated by the regular 10 members staff tasting committee of Food Science Department, Faculty of Agriculture, Ain Shams University, Fermented milk samples were assessed for appearance (10 point), texture and body (30 point), and flavor (60 point), according to Clark and Costello (2009).

2.8 Statistical analysis

Statistical analysis was done in accordance to (SAS Institute 2003) using of the general linear model with the main impact of treatments. Duncan's multiple ambitions were used to separate the means 3 refined at $P \leq 0.05$.

3 Results and Discussion

3.1 Chemical composition of synbiotic fermented milk

Starter cultures used did not affect the dry matter content of synbiotic fermented milk **(Table 1)**. Meanwhile, the addition of maltodextrin or inulin as prebiotics gave a close result compared with skim milk powder on dry matter content. The dry matter contents augmented slightly into all synbiotic fermented milk as the cold storage time interval reaches 21 days. This augment in the dry matter content during the storage period may be due to the evaporation of water and acidity development (El Batawy and Khalil 2018). However, ash content was not significantly different in all treatments and sample control during storage interval. Thus, starter cultures and the addition of maltodextrin or inulin had no significant influence (p-value) on ash content in synbiotic fermented milk products. Ash content (0.764% – 0.807%) in fresh synbiotic fermented milk samples and slightly augmented (0.789% – 0.834%) was recorded at the end of the storage period. Slight variations were observed in the ash content of synbiotic fermented milk during the cold storage period and they may be linked to dry matter changes.

The highest TA content was recorded on synbiotic fermented milk incorporated with 2% maltodextrin and inoculated yoghurt starter culture (T3). Synbiotic fermented milk with 2% skim milk powder and *Lb. acidophilus* had the least significant TA (T6) among all treatments. At the end of the storage period, TA varied from 1.10% to 1.41% and the pH from 4.01 to 4.06. In general, pH is reduced, and TA gradually increased in all treatments and control samples during

Table 1. Chemical composition of synbiotic fermented milk containing various probiotic strains and conventional culture and 2% maltodextrin or inulin along storage at 4°C for 21 days

Treatment	Storage period (day)			
	Fresh	7	14	21
		Dry matter %		
C	14.91^{Ab}	15.01^{Aab}	15.22^{Aa}	15.66^{Aa}
T1	14.62^{Ac}	14.74^{Abc}	14.98^{Ab}	15.50^{Aa}
T2	14.71^{Ac}	14.82^{Abc}	15.02Ab	15.53^{Aa}
T3	14.85^{Ab}	14.95^{Ab}	15.14^{Aab}	15.61^{Aa}
T4	14.73^{Ac}	14.84^{Ab}	14.96^{Ab}	15.48^{Aa}
T5	14.68^{Ac}	14.75^{Abc}	14.90^{Ab}	15.41^{Aa}
T6	14.89^{Ac}	14.96^{Abc}	15.12^{Ab}	15.60^{Aa}
T7	14.74^{Ac}	14.86^{Abc}	15.02^{Ab}	15.50^{Aa}
T8	14.56^{Ac}	14.69^{Ac}	14.90^{Ab}	15.41^{Aa}
		Ash%		
C	0.806^{Ab}	0.816^{Aab}	0.827^{Aa}	0.830^{Aa}
T1	0.764^{Bb}	0.777^{Bab}	0.784^{Ba}	0.789^{Ba}
T2	0.792^{ABb}	0.802^{Aa}	0.815^{Aa}	0.819^{Aa}
T3	0.803^{Ab}	0.815^{Aab}	0.826^{Aa}	0.831^{Aa}
T4	0.770^{Bb}	0.782^{ABab}	0.794^{ABa}	0.798^{Aa}
T5	0.782^{ABb}	0.791^{Aab}	0.802^{Aa}	0.807^{Aa}
T6	0.807^{Ab}	0.818^{Aab}	0.829^{Aa}	0.834^{Aa}
T7	0.784^{ABb}	0.795^{Aab}	0.805^{Aa}	0.810^{Aa}
T8	0.791^{ABb}	0.802^{Aab}	0.812^{Aa}	0.815^{Aa}
		TA %		
C	0.83^{Ad}	0.90^{Ac}	1.13^{Ab}	1.31^{Aa}
T1	0.83^{Ad}	0.91^{Ac}	1.14^{Ab}	1.32^{Aa}
T2	0.87^{Ad}	0.93^{Ac}	1.20^{Ab}	1.41^{Aa}
T3	0.76^{Bd}	0.89^{Ac}	1.06^{ABb}	1.26^{Aa}
T4	0.83^{Ad}	0.93^{Ac}	1.15^{Ab}	1.30^{Aa}
T5	0.81^{Ad}	0.92^{Ac}	1.12^{Ab}	1.29^{Aa}
T6	0.75^{Bd}	0.87^{Ac}	0.97^{Bb}	1.10^{Ba}
T7	0.78^{Bd}	0.90^{Ac}	0.99^{Bb}	1.11^{Ba}
T8	0.76^{Bd}	0.89^{Ac}	0.98^{Bb}	1.13^{Ba}
		SN/TN%		
C	0.6976^{Aa}	0.7072^{Aa}	0.721^{Aa}	0.721^{Aa}
T1	0.5456^{Ba}	0.552^{Ba}	0.556^{Ba}	0.563^{Ba}
T2	0.5472^{Ba}	0.5568^{Ba}	0.561^{Ba}	0.564^{Ba}
T3	0.6992^{Aa}	0.7136^{Aa}	0.723^{Aa}	0.726^{Aa}
T4	0.5456^{Ba}	0.5536^{Ba}	0.558^{Ba}	0.569^{Ba}
T5	0.544^{Ba}	0.555^{Ba}	0.561^{Ba}	0.568^{Ba}
T6	0.696^{Aa}	0.710^{Aa}	0.7184^{Aa}	0.723^{Aa}
T7	0.544^{Ba}	0.552^{Ba}	0.560^{Ba}	0.566^{Ba}
T8	0.5472^{Ba}	0.556^{Ba}	0.561^{Ba}	0.568^{Ba}
		Acetaldehyde (µml/100 g)		
C	265.17^{Ba}	238.96^{bb}	148.96^{Bc}	115.74^{Bd}
T1	268.96^{Ba}	231.37^{Bb}	145.17^{Bc}	117.85^{Bd}
T2	266.89^{Ba}	231.03^{Bb}	147.93^{Bc}	119.66^{Bd}
T3	270.15^{Ba}	246.41^{ABb}	162.53^{Bc}	125.80^{ABd}
T4	276.10^{ABa}	251.60^{Ab}	170.9^{Ac}	130.11^{Ad}
T5	275.25^{ABa}	253.53^{Ab}	171.85^{Ac}	131.12^{Ad}
T6	276.50^{ABa}	248.11^{ABb}	174.15^{Ac}	131.15^{Ad}
T7	282.14^{Aa}	254.12^{Ab}	176.82^{Ac}	135.20^{Ad}
T8	280.26^{Aa}	253.26^{Ab}	179.50^{Ac}	137.70^{Ad}
		Diacetyl (µml/100 g)		
C	13.88^{Bb}	14.91^{Ba}	11.42^{Cc}	9.50^{Cd}
T1	14.01^{ABb}	15.16^{Ba}	12.02^{Bc}	10.10^{Bd}
T2	13.9^{Bb}	15.05^{Ba}	11.81^{BCc}	10.01^{Bd}
T3	15.42^{Ab}	16.91^{Aa}	13.24^{Ac}	11.12^{Ad}
T4	16.15^{Ab}	17.11^{Aa}	13.60^{Ac}	11.26$_{Ad}$
T5	16.25^{Ab}	17.20^{Aa}	13.68^{Ac}	11.30^{Ad}
T6	14.51^{ABb}	15.81^{ABa}	13.14^{Ac}	11.01^{Ad}
T7	14.82^{ABb}	16.01^{ABa}	13.25^{Ac}	11.10^{Ad}
T8	14.90^{ABb}	16.10^{ABa}	13.26^{Ac}	11.15^{Ad}

C, T1, and **T2**: fermented milk made with 2% yoghurt starter culture fortified with 2% of skim milk powder, inulin, and maltodextrin, respectively.
T3, T4, and **T5**: fermented milk made with 2% *Lb. helveticus* and fortified with 2% of skim milk powder, inulin, and maltodextrin, respectively.
T6, T7, and **T8**: fermented milk made with 2% *Lb. acidophilus* and fortified with 2% of skim milk powder, inulin, and maltodextrin, respectively.

the storage period. Fermented milk samples made with yoghurt starter culture had the highest value of acidity and lowest pH than the other treatments.

The addition of maltodextrin or inulin into synbiotic fermented milk caused an increase in TA and subsequently decreased pH. These results may be because of the high carbohydrate content that enhanced the survival of lactic acid bacteria (El-Kholy et al 2020). The TA progressively increased in all synbiotic fermented milk treatments during the storage period, and this finding may be due to the activity of fermented milk culture (El Batawy and Khalil 2018). The formation of starter cultures, maltodextrin or inulin addition, and storage interval can affect the general acidity of stored yoghurt samples (Bisar et al 2015).

Starter culture type, maltodextrin or inulin addition, and storage period significantly affected the SN/TN content in all synbiotic fermented milk samples. The SN/TN content (%) increased in all synbiotic fermented milk treatments as the cold storage interval increased to 21 days. Significant differences ($p < 0.05$) were recorded in SN/TN content between samples containing skim milk powder and other treatments containing maltodextrin or inulin when fresh and during storage. The SN/TN content was significantly higher in the synbiotic fermented milk fortified with 2% of skim milk powder than in all other treatments. The SN/TN content (%) increased significantly in synbiotic fermented milk samples containing *Lb. acidophilus* or *Lb. helveticus* cultures with maltodextrin or inulin than those treated with yoghurts cultures. This finding may be due to the high proteolytic activity of *Lb. helveticus* and *Lb. acidophilus* cultures. These results agree with those reported by Donkor et al (2007a) and Shihata and Shah (2000).

Acetaldehyde and diacetyl are the main volatile complexes responsible for the aroma and, play a fundamental role in flavor development in synbiotic fermented milk products along the cold storage. No significant differences were recorded in acetaldehyde and diacetyl contents among the control fermented milk samples and the other treatments when fresh and during the storage period. Meanwhile, the acetaldehyde contents were significantly high in synbiotic fermented milk treatments T4, T6, T7, and T8. The storage period had a significant impact on acetaldehyde and diacetyl contents compared with the fresh control sample. These results agree with those obtained by Yuguchi et al (1989). Otherwise, the addition of 2% maltodextrin or inulin in synbiotic fermented milk containing yoghurt starter culture had no impact on the acetaldehyde and, diacetyl contents in the final synbiotic fermented milk. This result may be because the maltodextrin or inulin had no impact on the activities and growth of yoghurt starter bacteria but motivated growth from *Lb. helveticus* and *Lb. acidophilus*. The decline in acetaldehyde contents during the storage period was because of the capability of several starter cultures to convert acetaldehyde to ethanol or oxidize it to acetic acid as reported in the report by Roushdy et al (1996). The decline in diacetyl was mostly because of the sluggish conversion of diacetyl to acetoin as reported by Roushdy et al (1996).

3.2 Apparent viscosity

The addition of maltodextrin or inulin to the synbiotic formula significantly increased ($p < 0.05$) viscosity of the synbiotic fermented milk **(Fig 1)**. Starter cultures had no significant influence on viscosity in all synbiotic fermented milk products. The high viscosity of synbiotic fermented milk containing maltodextrin or inulin can be attributed to the confinement of water into the gel because of the combined impact of gelation of milk, maltodextrin, and inulin. Bisar et al (2015) proposed that the rise in apparent viscosity in fermented skimmed milk products supported for maltodextrin or inulin can be attributed to the fractional hydrolysis of various starches from the beginning and the acceleration of the formation of maltodextrin or inulin gel. The outer linear chain of amylopectin is thought to react with amylose, decreasing its self-linking and leading to the formation of a common interconnected network (Oliveira et al 2009). Therefore, the apparent viscosity of all synbiotic fermented milk products gradually increased during the cold storage interval. In addition, Donkor et al (2007b), reported that the viscosity values from various probiotic yoghurts increased during storage at 5°C.

3.3 Microbiological analysis

Str. thermophilus and *Lb. delbrueckii* subsp. *Bulgaricus* counts were high in conventional yoghurt samples made with 2% of yoghurt starter cultures compared with all other treatments **(Table 2)**. *Lb. delbrueckii* subsp. *bulgaricus* and *Str. thermophiles* counts were significantly reduced during the first week of storage and reduced progressively even at the end of the storage period. The same result was achieved before by (El-Kholy et al 2020). A gradual decrease was noticed in the survival of probiotic

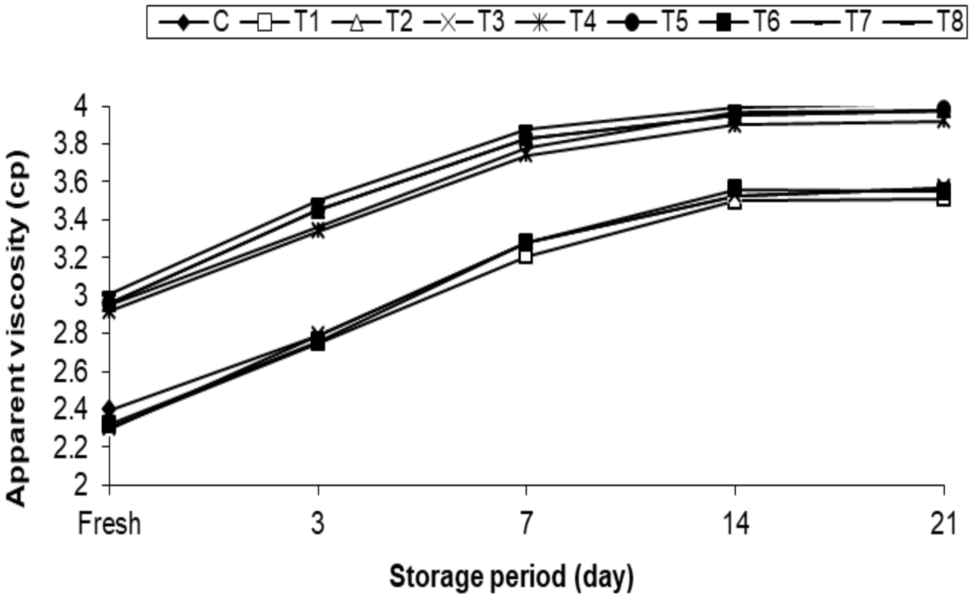

Fig 1. Apparent viscosity values (at γ = 145.8 s^{-1}) of synbiotic fermented milk containing various probiotics strains and conventional cultures as well as 2% maltodextrin or inulin along with storage for 21 days at 4 ºC . *See **Table 1** for details

strains (*Lb. helveticus,* and *Lb. acidophilus)* in synbiotic fermented milk as the storage interval progressed. The reduction in probiotic counts was due to the sensitivity of starter cultures to acid development during the storage interval (Bisar et al 2015, Paseephol and Sherkat 2009).

Adding 2% maltodextrin or inulin as prebiotics in the production of synbiotic fermented milk had no significant effect on the survival of the probiotics strains (*Lb. helveticus* and *Lb. acidophilus*) and yoghurt cultures along the storage period. These findings are in line with those of (El Batawy and Khalil 2018). Food products intended populations over 10^6 cfu probiotic /g during the time of consumption of the strains added to food. However, the viability of the probiotics strains (*Lb. helveticus.* and *Lb. acidophilus)* in synbiotic fermented milk made with or without inulin as prebiotics was higher along the storage period for 21 days at 4ºC than the minimum recommended levels of 10^6 CFU/mL or g (El Batawy and Khalil 2018).

Yeast and mold counts cannot be detected in all fresh samples and appeared during observation post seven days of storage of the sample treatments (C, T1, T3, T6, and T7) and post 14 days in treatments (T3, T5, T6, and T8). The counts slightly increased as the storage period increased. Fresh synbiotically fermented milk containing various probiotics conventional cultures and maltodextrin or inulin with a cold storage period of 21 days were devoid of coliforms bacteria. This result may be because of effective heat processing of the standardized milk (10 min at 90°C). Higher sewage conditions during manufacturing and storage, as well as the impact of acidity in various synbiotic fermented milk when it plays a key role in lowering the coliforms bacteria growth average (El Batawy and Khalil 2018).

3.4 Organoleptic properties

Slight changes in appearance scores were recorded between all treatments over the first seven days of the storage period. Afterward, the appearance points declined with the progression of the storage period, to reach 6 or 7 points for all samples at the finish of the storage period (21 days) **(Table 3)**. The cultures utilized and the addition of maltodextrin or inulin did not impact the appearance of various synbiotic fermented milk. The panels found significant differences in each sample in terms of flavor, texture body, and general admission, reflecting the advantages of probiotic cultures and maltodextrin or inulin as active ingredients in the general organoleptic characteristics of fermented milk.

The greatest texture and body scores (29) were registered in fresh synbiotic fermented milk with yoghurt cultures and supported with 2% maltodextrin (T2).

Table 2. Bacteriological characteristics (log CFU/mL) of synbiotic fermented milk containing various probiotic strains and conventional culture as well as 2% maltodextrin or inulin along storage at 4°C for 21 days

Treatment	**Storage Period (day)**			
	Fresh	**7**	**14**	**21**
	Str. thermophiles			
C	7.64^{Bb}	7.78^{Ba}	7.37^{Bc}	6.51^{Bd}
T1	7.90^{Aa}	7.98^{Aa}	7.52^{Ab}	6.87^{Ac}
T2	7.89^{Aa}	7.93^{Aa}	7.49^{Ab}	6.79^{Ac}
	Lb. delbrueckii* subsp. *bulgaricus			
C	8.23^{Ca}	8.30^{Ca}	7.76^{Bb}	7.20^{Bc}
T1	8.66^{Aa}	8.72^{Aa}	7.98^{Ab}	7.43^{Ac}
T2	8.55^{Ba}	8.62^{Ba}	7.90^{Ab}	7.35^{Ac}
	Lb. helveticus			
T3	7.56^{Cb}	7.91^{Ba}	7.32^{Cc}	6.50^{Cd}
T4	7.97^{Ab}	8.12^{Aa}	7.68^{Ac}	6.94^{Ad}
T5	7.76^{Bb}	8.02^{Aa}	7.51^{Bc}	6.85^{Bd}
	Lb. acidophilus			
T6	8.43^{Ca}	8.53^{Ca}	7.64^{Bb}	6.81^{Cb}
T7	8.51^{Ba}	8.61^{Ba}	7.98^{Ab}	7.03^{Bb}
T8	8.67^{Aa}	8.76^{Aa}	7.89^{Ab}	7.26^{Bb}
	Yeast* and *mold			
C	0	2.3	2.4	2.73
T1	0	2	2.3	2.65
T2	0	0	2	2.3
T3	0	2	2.3	2.58
T4	0	0	2	2.3
T5	0	0	2	2.3
T6	0	2.3	2.4	2.75
T7	0	2	2.3	2.58
T8	0	0	2	2.31

*See **Table 1** for details.

Meanwhile, the fresh control fermented milk made with yoghurt cultures (C) had the least texture and body grades (25). The greatest remarkable flavor score points (58) were registered in synbiotic fermented milk together with maltodextrin (T5, and T8). The inoculation of *Lb. helveticus* and *Lb. acidophilus* as starter cultures in synbiotic fermented milk manufacture improved flavor grades.

Synbiotic fermented milk's flavor, texture, and body points were improved by adding maltodextrin or inulin as a prebiotic. This result can be because of the water-binding ability of the low-molecular-weight polymer in maltodextrin and inulin (Sikorski 2006). Therefore, using the probiotic culture combinations and maltodextrin or inulin affirmatively affects the general organoleptic characteristics (Ranjeeta 2011). Maltodextrin and inulin are commonly complex mixtures of molecular types ranging from glucose to long (branched and linear) polymeric chains (Roller 1996).

The total scores of the control content and all other treatment samples were higher in the fresh state, followed by a gradual decline ($p < 0.05$) until the finish of the storage period. The total score points ranged from 67 (C) to 80 points (T5) at the finish of the storage period. This decline may exist because of acidity evolution or production of other microbial during metabolism, which affected the rheological and organoleptic characteristics. The results also conclude that it is possible to extend the shelf life of synbiotic fermented milk over 14 days at 4 ºC because of the decrease in the organoleptic characteristics of all samples (El Batawy and Khalil 2018).

Table 3. Organoleptic properties of synbiotic fermented milk containing various probiotic strains and conventional culture as well as 2% of maltodextrin or inulin during storage at 4°C for 21 days

Characteristics	Treatments	Storage period (day)			
		Fresh	7	14	21
Appearance (10)	C	9	9	8	7
	T1	9	8	7	6
	T2	8	8	7	6
	T3	9	9	8	7
	T4	9	8	7	6
	T5	8	9	8	7
	T6	9	9	8	7
	T7	9	8	7	6
	T8	8	7	7	6
Body and Texture (30)	C	25	24	23	20
	T1	28	27	26	23
	T2	29	28	27	25
	T3	26	25	24	21
	T4	28	27	26	24
	T5	28	27	26	24
	T6	25	24	23	20
	T7	28	26	25	24
	T8	28	27	25	24
	C	51	50	48	40
Flavor (60)	T1	55	54	51	42
	T2	56	55	54	48
	T3	53	51	50	49
	T4	56	54	52	48
	T5	58	56	55	50
	T6	55	53	50	49
	T7	56	50	49	46
	T8	58	49	47	45
Total (100)	C	85^{Ba}	83^{Ba}	79^{Cbc}	67^{Dc}
	T1	92^{Aa}	89^{Ab}	84^{Bc}	71^{Cd}
	T2	93^{Aa}	91^{Ab}	88^{Ac}	79^{Ad}
	T3	88^{Ba}	85^{ABb}	82^{Cc}	77^{Bd}
	T4	93^{Aa}	89^{Ab}	85^{Bc}	78^{ABd}
	T5	94^{Aa}	92^{Ab}	89^{Ac}	80^{Ad}
	T6	89^{Ba}	86^{ABb}	81^{Cc}	76^{Bd}
	T7	93^{Aa}	84^{Bb}	81^{Cc}	76^{Bd}
	T8	94^{Aa}	83^{Bb}	79^{Cc}	75^{Bd}

*See **Table 1** for details.

4 Conclusion

In conclusion, it could be concluded that, different probiotic strains such as *Lb. helveticus* and *Lb. acidophilus* can be combined to produce synbiotic fermented milk with 2% maltodextrin or inulin as prebiotics during synbiotic fermented milk production to enhance the survival of the probiotics strains and organoleptic characteristics of the final product along with the storage interval, and it is recommended to use in the industry.

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