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Apricot Probiotic Drinking Yoghurt Supplied with Inulin and Oat Fiber

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Abstract

In this study, the effects of different amounts of inulin and oat fiber addition on the properties of apricot probiotic drinking yoghurt (APDY) were investigated. Seven different APDY was produced. Six of them were produced by the addition of 0.5%, 1% and 2% inulin (B, C, D) and oat fiber (E, F, G) and one of them was produced as control sample. Pasteurized apricot pureed and sugar (10%) was added to fermented milk beverage. APDYs were analysed 1, 7, 14 and 21 days after production. Addition of fiber to APDYs had significantly affected on the pH, titratable acidity, water holding capacity, *S. thermophilus, L. acidophilus Bifidobacterium* BB-12 counts, and sensorial properties of the samples ($p < 0.01$). pH values decreased titratable acidity, water holding capasity, the viscosity values, *L. acidophilus* and *Bifidobacterium* BB-12 counts increase by the addition of fiber into samples.

Keywords

Probiotic Drinking Yoghurt, Inulin, Oat Fiber

1. Introduction

Because of their attributed health benefits, probiotic bacteria have been increasingly included in yoghurts and fermented milks during the past three decades and they are consumed at appropriate levels and as part of a balanced diet. In order to produce therapeutic benefits, a suggested minimum level for probiotic bacteria in fermented milk is from 10^6 to 10^7 cfu mL^{-1} [1]. Therefore, manufacturers are interested in developing process that can provide high densities of the probiotic strains in the product. For example, supplementing milk with a combination of protein hydrolysates, fructose whey protein concentrate, tomato juice and papaya pulp stimulated *L. acidophilus,* while cysteine, acid hydrolysates, tryptone, vitamins, dextrin and maltose improved the viability of *Bifidobacteria*. Prebiotics, such as oligosaccharides are added to food mainly to

allow the preferential growth of probiotic organisms [2].

Inulin and oat fiber, the nondigestible carbohydrate containing naturally occuring fructooligosaccharides and β-glucan, respectively, possesses some characteristics of dietary fibers, and such is of particular interest for its metabolic properties [3] [4] [5]. Inulin and oat fiber are carbohydrate-derived fat replacers possessing gelling capacity with water and have low calories [6] [7]. Besides theirs health benefits, inulin and oat fiber are also considered to have prebiotic properties such as the ability to situmulate probiotic bacteria without affecting flavour [3] [8] [9]. Due to their prebiotic effect, addition of inulin or oat fiber can improve probiotic bacteria. There is, however, a low consumption of oat-based products, mainly due to the lack of acceptable and suitable food products [6]. Apricot is a rich source of sugars, fibers, minerals, bioactive phytochemicals and vitamins like A, C, thiamine, riboflavin, niacin and pantothenic acid [10] and could be used for formulations of dairy products. Apricot probiotic drinking yoghurt (APDY) can be used for this purpose.

The aim of this study was to establish the maximum level of fibre that could be incorporated into drinking yoghurt and thus, to produce an acceptable APDYs containing apricot and diatery fibers and high levels of probiotic bacteria (>10^6 - 10^7 cfu g^{-1}, which is the recommended minimum daily intake).

2. Materials and Methods

2.1. Materials

APDYs production were done in the Dairy Pilot Plant of the Food Engineering Department of Harran University. The cow milks were inoculated with mixed probiotic culture (FD-DVS ABT-2 Probio-Tec) consisting of *Streptococcus thermophilus, Lactobacillus acidophilus* and *Bifidobacterium* BB-12. The starter cultures were obtained from Peyma-Chr. Hansen (Turkey). Inulin and oat fiber were supplied from Arosel Gıda (İstanbul). Apricot and sugar were purchased from markets. All reagents used in this work were of analytical grade and obtained from Sigma Chemicals (İstanbul, Turkey).

2.2. Production of Apricot Probiotic Drinking Yoghurt (APDY)

Drinking yoghurt was manufactured according to Tamime and Robinson [11]. Two different trials were performed for the manufacture of APDY. The fat of milks was standardized to 3% (w/v) by separating cream and non fat dry matter contents of milks was standardized to 6% dry matter (w/v) by addition of water and homogenized at 175 bar. Milk was divided into seven equal portions (each 5 litres). The first batch (A) was control. Inulin was added to the second (A), third (B) and fourth (C) batches at a rate of 0.5%, 1% and 2%, respectively. Oat fiber was added to the fifth (D), sixth (E) and seventh (F) batches at a rate of 0.5%, 1% and 2%, respectively. After heat-treated at 90˚C for 10 min, milks cooled to 42˚C and were inoculated with probiotic culture at a rate of 5% (about 10^6 cfu mL^{-1}) and the batches were incubated at 37˚C until pH 4.6. On the other hand, one part of apricot puree was heated with one part of sugar (w/w) at 90˚C

for 2 min. After cooling it was added to probiotic fermented milk beverage at a rate of 10%. Dry matter of APDYs were approximately between 13% and 15%. After stirring with an electric mixer (Moulinex, France) for 3 min at low speed (less than 20 rpm), the bevarages dispensed into plastic cups (200 ml) and closed with aluminum covers. Then they were transferred to a cold store (4˚C ± 1˚C) immediately.

2.3. Chemical Analysis

The pH of the milk and APDYs was measured using a digital pH-meter. Titratable acidity, expressed as g of lactic acid per 100 g APDY, was evaluated by titration method and the total fat contents were determined by the Gerber method, respectively [1]. The protein, moisture and ash contents of milk, and APDYs were estimated from the crude nitrogen content of the samples determined by the Kjeldahl, oven-drying and gravimetric methods, respectively [12].

2.4. Physical Measurements

The water holding capacity (WHC) was determined with a procedure adapted from Remeuf *et al.* [13]. A sample of about 20 g of native APDY was centrifuged for 10 min at 483 × g and 20˚C. The whey expelled (WE) was removed and weighed. The WHC was defined as WHC (%) = 100 (APDY-WE)/APDY.

The viscosity of the APDYs was determined at 4˚C using a digital Brookfield Viscometer, Model DV-II (Brookfield Engineering Labrotories, Stoughton, MA, USA) [14].

Bacteriological analysis

APDY samples (10 g) were decimally diluted in 100 mL sterile peptone water (0.1%) and 1 mL aliquot dilutions were poured onto plates of the various selective and differential agars in triplicate. *S. thermophilus*, *L. acidophilus* and *Bifidobacterium* BB-12 were incubated by using M17 agar, MRS with sorbitol agar and MRS-NNLP [1], respectively. All plates were incubated at 37˚C for 72 h. M17 was incubated aerobically, whereas all other media plates were incubated anaerobically. Anaerobic conditions were created using Anaerocult A sachets (Merck). Plates containing 20 - 200 colonies were counted and the results are expressed as colony-forming units per gram (cfu g^{-1}) of sample.

2.5. Sensory Assessment

The samples were organoleptically assessed by ten panelists using a 9-point hedonic scale was used to evaluate flavour, texture, appearance and general acceptability (1 = strongly unacceptable, 9 = very good) as described by Bodyfelt *et al.* [15]. The panel of assessors was an external panel of non-smokers who were very familiar with fermented dairy products and were selected on the basis of sensory acuity and consistency. Judges developed a list of terms describing flavour and physical properties of yoghurt samples. The vocabulary comprised: (a) three attributes for colour and appearance (***whey separation***: non separated, slightly separated and too much separated and ***colour***: normal, pale orange and dark orange) (b) three attributes for consistency (gel-like, too firm and too thin) (c) five attributes for flavour (intensity, acid/sour, sweet, flour flavour and

other) (d) three attributes for general acceptability (very good, neither good not bad, very bad).

2.6. Statistical Analysis

The data were analysed statistically by means of SPSS statistical software program (version 5.0). Statistically different groups were determined by the LSD (Least Significant Difference) test [16].

3. Results and Discussions

3.1. Physical and Chemical Characteristics

The chemical composition of milk used for the production of APDY (data not shown) fell within the following averages: titratable acidity 0.18 (±0.01) % as lactic acid (L. A.), pH 6.68 (±0.02), total solids 11.78% (±0.06), fat 3.1% (±0.03), protein 3.34% (±0.07), lactose 4.58% (±0.06) and ash 0.73% (±0.01).

The changes of physico-chemical properties of APDY are shown in **Table 1**. Initial pH of milk (6.68) decreased to 4.15 - 4.62 at 1st day in APDYs. The pH values of the APDY samples contain fiber were lower and the acidity level were higher than control sample. The pH values of the APDY samples with inulin were lower and the acidity level of the APDY samples with inulin were higher than the samples with oat fiber. Gonzales *et al.* [17] reported that similar results in peach flavored yoghurt drinks made with prebiotic and probiotic bacteria from whole milk. With the increase in fiber content, pH values were slightly decreased and acidity level increased ($p < 0.01$). The pH of the samples decreased and the acidity level increased continuously throughout storage period for all the samples. Guven *et al.* [18], Sahan *et al.* [19] and Sengul *et al.* [20] reported that titratable acidity increased during storage period in yoghurt made with fruits or fiber.

Addition of fiber had a positive effect on the WHC of APDYs. The highest WHC was obtained for sample G, which fortified with 2% oat fiber. With the increase in fiber content, WHC values were increased ($p < 0.01$). Oat fiber and inulin are highly hygroscopic, could bind water and form a gel-like network [3] [21].

Addition of fiber, especially oat fiber increased the viscosity of APDY ($p < 0.01$). The viscosity value of the sample F was the highest and the control sample was the least. Several authors reported that dietary fiber in fermented milk products increase the viscosity of the end product [18] [19] [22] [23]. According to Robinson [24], inulin would raise the viscosity as a consequence of the higher total solid content. A positive correlation was found between viscosity and fiber level of the samples ($p < 0.01$). In general, the higher total solid content of milk, the higher viscosity values in the samples. Viscosity values of the samples increased during storage. It is known that depending on the decrease in pH, the protein-protein interactions and therefore, slow protein rearrangements in the acid casein gels continue during cold storage [14]. Sahan *et al.* [19] were reported that viscosity values of the yoghurts with β-glucan were increased throughout storage.

Table 1. The changes of physico-chemical properties of FMB during storage period.

Sample*	Storage period	pH	Titratable acidity (%L. A)	Viscosity (Cp)	Water holding capacity (%)
A	1.day	4.62 ± 0.049^{a1A}	0.501 ± 0.001^{c2D}	1126 ± 8.485^{d4C}	77.91 ± 1.216^{e3A}
	7.day	4.54 ± 0.049^{a1B}	0.535 ± 0.006^{b2C}	1170 ± 19.799^{d3B}	77.08 ± 1.386^{e3A}
	14.day	4.42 ± 0.064^{a1B}	0.581 ± 0.037^{c3B}	1200 ± 22.627^{c3A}	76.49 ± 1.054^{d2A}
	21.day	4.33 ± 0.035^{a1C}	0.625 ± 0.004^{c3A}	1228 ± 11.314^{c2A}	75.39 ± 1.945^{e2B}
B	1.day	4.56 ± 0.078^{a1A}	0.542 ± 0.006^{b1B}	1222 ± 31.113^{c3C}	81.47 ± 1.181^{d2A}
	7.day	4.49 ± 0.085^{a1A}	0.552 ± 0.006^{b2B}	1260 ± 11.314^{c2B}	79.90 ± 0.79^{d2A}
	14.day	4.37 ± 0.049^{a1B}	0.633 ± 0.014^{b2A}	1308 ± 5.657^{c2A}	77.95 ± 1.301^{d2B}
	21.day	4.30 ± 0.064^{b1C}	0.651 ± 0.029^{b2A}	1332 ± 5.657^{b1A}	76.90 ± 0.962^{e2B}
C	1.day	4.49 ± 0.021^{b1A}	0.554 ± 0.004^{a1C}	1264 ± 11.314^{b2C}	88.35 ± 1.937^{c1A}
	7.day	4.38 ± 0.035^{b2B}	0.585 ± 0.005^{a1B}	1290 ± 8.485^{b2B}	86.64 ± 2.220^{c1A}
	14.day	4.30 ± 0.021^{c1B}	0.674 ± 0.004^{a1A}	1330 ± 2.828^{c1A}	85.66 ± 0.955^{c1B}
	21.day	4.21 ± 0.028^{c1C}	0.688 ± 0.011^{a1A}	1343 ± 4.243^{b1A}	84.16 ± 0.559^{d1B}
D	1.day	4.46 ± 0.0072^{b1A}	0.564 ± 0.002^{a1C}	1331 ± 1.414^{a1A}	89.41 ± 0.919^{c1A}
	7.day	4.32 ± 0.028^{b2B}	0.592 ± 0.008^{a1B}	1352 ± 11.314^{a1A}	88.38 ± 0.742^{b1A}
	14.day	4.24 ± 0.028^{c2C}	0.678 ± 0.002^{a1A}	1358 ± 8.485^{b1A}	86.93 ± 1.237^{c1B}
	21.day	4.15 ± 0.042^{d2D}	0.697 ± 0.010^{a1A}	1359 ± 12.728^{a1A}	86.03 ± 0.933^{c1B}
E	1.day	4.59 ± 0.007^{a1A}	0.548 ± 0.005^{b1C}	1280 ± 11.314^{b2B}	91.59 ± 0.785^{b2A}
	7.day	4.49 ± 0.042^{a1B}	0.571 ± 0.025^{a1C}	1294 ± 14.142^{b2B}	89.89 ± 1.117^{b2A}
	14.day	4.43 ± 0.021^{a1B}	0.616 ± 0.008^{b1B}	1336 ± 11.314^{b2A}	87.15 ± 1.174^{b3B}
	21.day	4.36 ± 0.028^{a1C}	0.641 ± 0.013^{c2A}	1358 ± 2.828^{a1A}	85.03 ± 0.127^{c3C}
F	1.day	4.54 ± 0.021^{b1A}	0.568 ± 0.002^{a1C}	1304 ± 22.627^{a1B}	93.12 ± 1.259^{a1A}
	7.day	4.47 ± 0.035^{b1A}	0.587 ± 0.007^{a1C}	1350 ± 8.485^{a1A}	91.95 ± 0.870^{a1A}
	14.day	4.36 ± 0.021^{b1B}	0.621 ± 0.008^{b1B}	1360 ± 5.657^{b1A}	89.69 ± 1.711^{b2B}
	21.day	4.32 ± 0.028^{a1B}	0.657 ± 0.016^{b1A}	1376 ± 0.000^{a1A}	88.63 ± 0.594^{b2B}
G	1.day	4.52 ± 0.078^{b12A}	0.576 ± 0.004^{a1C}	1334 ± 19.799^{a1B}	94.11 ± 1.351^{a1A}
	7.day	4.43 ± 0.035^{b1B}	0.584 ± 0.006^{a1C}	1362 ± 14.142^{a1A}	93.48 ± 1.690^{a1A}
	14.day	4.32 ± 0.021^{b2C}	0.625 ± 0.001^{b1B}	1388 ± 5.657^{a1A}	92.21 ± 2.524^{a1B}
	21.day	4.27 ± 0.014^{c2C}	0.672 ± 0.009^{b1A}	1384 ± 5.657^{a1A}	91.06 ± 1.803^{a1B}

***A:** Control, **B:** Fortified with inulin at 0.5%, **C:** Fortified with inulin at 1.0%, **D:** Fortified with inulin at 2.0%, **E:** Fortified with oat fiber at 0.5%, **F:** Fortified with oat fiber at 1.0%, **G:** Fortified with oat fiber at 2.0%; $^{a-d}$Different letters in the same column denote significant differences for fiber addition ($P < 0.01$). Different numbers in the same column denote significant differences for fiber rate storage period ($P < 0.01$). Different capital letters in the same column denote significant differences for storage period ($P < 0.01$).

3.2. Bacterial Counts

Viable bacterial counts of APDY samples during storage are shown in Table 2. Addition of fiber had no effect on the *S. thermophilus* counts of samples ($p > 0.05$). Gee *et al.* [22], Vasiljevic *et al.* [25] and Kearney *et al.* [23] also reported that the addition of

exogenous barley or oat β-glucan concentrates had no effect on the growth of yoghurt starter cultures. The counts of *S. thermophilus* raised slowly during the storage up to 14 day, and declined later about 0.5 - 0.8 log cycle. This could be due to the stimulated growth of Streptococcus species by essential amino acids occured during 14 day storage. After 14 days, lactic acid could made the environment unfavorable for the growth of Streptococcus species. Similar results were reported by Guler-Akin and Akin [1], Kearney *et al.* [23].

Table 2. The changes of viable bacteria counts of FMBs during storage period (log cfu g^{-1}).

Sample*	Storage period	*Streptococcus thermophilus*	*Lactobacillus acidophilus*	*Bifidobacterium* BB-12
A	1.day	6.93 ± 0.106^{1B}	6.04 ± 0.028^{d2A}	5.21 ± 0.035^{c2A}
	7.day	7.08 ± 0.106^{1B}	5.94 ± 0.007^{c1A}	5.09 ± 0.057^{c1A}
	14.day	7.66 ± 0.120^{1A}	5.91 ± 0.014^{c1A}	4.99 ± 0.014^{b1B}
	21.day	6.78 ± 0.240^{1A}	5.83 ± 0.028^{c2B}	4.93 ± 0.035^{b2B}
B	1.day	6.98 ± 0.085^{1B}	6.15 ± 0.035^{d2A}	5.35 ± 0.021^{b1A}
	7.day	7.12 ± 0.085^{1B}	6.10 ± 0.021^{c1A}	5.13 ± 0.035^{c1B}
	14.day	7.74 ± 0.085^{1A}	6.03 ± 0.035^{d1A}	4.97 ± 0.021^{b2C}
	21.day	6.09 ± 0.127^{2C}	5.94 ± 0.021^{c1B}	4.98 ± 0.035^{b2B}
C	1.day	7.06 ± 0.064^{1B}	6.48 ± 0.007^{c1A}	5.36 ± 0.028^{b1A}
	7.day	7.27 ± 0.049^{1B}	6.03 ± 0.035^{c1B}	5.21 ± 0.042^{b1B}
	14.day	7.75 ± 0.099^{1A}	6.02 ± 0.085^{d1B}	5.00 ± 0.141^{b1C}
	21.day	6.24 ± 0.078^{2C}	6.03 ± 0.035^{b1B}	5.03 ± 0.099^{b2C}
D	1.day	7.07 ± 0.148^{1B}	6.54 ± 0.007^{b1A}	5.49 ± 0.332^{a1A}
	7.day	7.34 ± 0.092^{1B}	6.13 ± 0.028^{c1B}	5.26 ± 0.035^{b1B}
	14.day	7.75 ± 0.127^{1A}	6.01 ± 0.057^{d1B}	5.14 ± 0.057^{a1B}
	21.day	6.22 ± 0.099^{2C}	6.05 ± 0.071^{b1B}	5.22 ± 0.120^{a1B}
E	1.day	6.88 ± 0.035^{1B}	6.51 ± 0.014^{c1A}	5.44 ± 0.014^{a1B}
	7.day	7.03 ± 0.113^{2B}	6.42 ± 0.021^{a1A}	4.97 ± 0.049^{d3C}
	14.day	7.42 ± 0.078^{2A}	6.36 ± 0.007^{b2B}	4.82 ± 0.049^{c2C}
	21.day	6.02 ± 0.120^{2C}	6.26 ± 0.127^{a1B}	5.10 ± 0.481^{a1B}
F	1.day	7.00 ± 0.120^{1C}	6.66 ± 0.007^{b1A}	5.50 ± 0.049^{a1A}
	7.day	7.02 ± 0.191^{2B}	6.27 ± 0.014^{b1B}	5.24 ± 0.057^{b2B}
	14.day	7.84 ± 0.078^{1A}	6.23 ± 0.035^{c2B}	5.05 ± 0.071^{b1C}
	21.day	6.41 ± 0.085^{1D}	6.10 ± 0.141^{b2C}	5.04 ± 0.156^{b1C}
G	1.day	7.04 ± 0.134^{1B}	6.80 ± 0.007^{a1A}	5.56 ± 0.035^{a1A}
	7.day	7.74 ± 0.057^{1A}	6.40 ± 0.007^{a1C}	5.48 ± 0.071^{a1A}
	14.day	7.99 ± 0.078^{1A}	6.58 ± 0.000^{a1B}	5.21 ± 0.078^{a1B}
	21.day	6.54 ± 0.092^{1C}	6.37 ± 0.304^{a1C}	5.14 ± 0.057^{a1B}

***A:** Control, **B:** Fortified with inulin at 0.5%, **C:** Fortified with inulin at 1.0%, **D:** Fortified with inulin at 2.0%, **E:** Fortified with oat fiber at 0.5%, **F:** Fortified with oat fiber at 1.0%, **G:** Fortified with oat fiber at 2.0%; $^{a-d}$Different letters in the same column denote significant differences for fiber addition ($P < 0.01$). Different numbers in the same column denote significant differences for fiber rate storage period ($P < 0.01$). Different capital letters in the same column denote significant differences for storage period ($P < 0.01$).

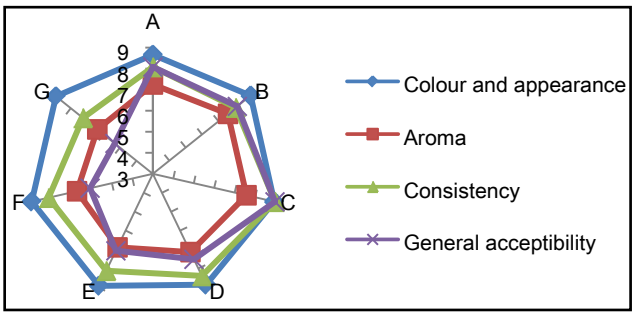
L. acidophilus counts of the samples fortified with oat fiber were higher than the other samples. Addition of inulin and oat fiber improve the viability of *L. acidophilus*. As increase in fiber content, *L. acidophilus* counts were increased ($p < 0.01$). Previous studies have reported on the ability of probiotic and yoghurt starter cultures to break down and utilise β-glucan or inulin [22] [26] [27]. The counts of *L. acidophilus* decreased during storage period. One of the most important factor which affected the viability of *L. acidophilus* are acidity [28]. Acidity of the samples increased during the storage period. Similar results were reported by Guler-Akin and Akin [1].

Addition of fiber improved the viability of *Bifidobacterium* BB-12. Inulin is a prebiotic can stimulate the metabolism of LABs, which was metabolized as an additional carbon and energy source [29]. Sendra *et al.* [30] and de Souza *et al.* [31] reported that fiber or/and inulin addition had increased metabolic activity of the Bifidobacteria. In addition Gee *et al.* [22] and Snart *et al.* [26] reported that probiotic and yoghurt starter cultures can utilise β-glucan. According to the our results, oat fiber improved survival of bifidobacteria more than inulin. The higher fiber content, the higher *Bifidobacterium* BB-12 counts in the samples ($p < 0.01$). pH values of APDY samples reduced during the storage period under 4.5 which is the critical value for Bifidobacteria survival. Thus *Bifidobacterium* BB-12 counts declined during the storage period.

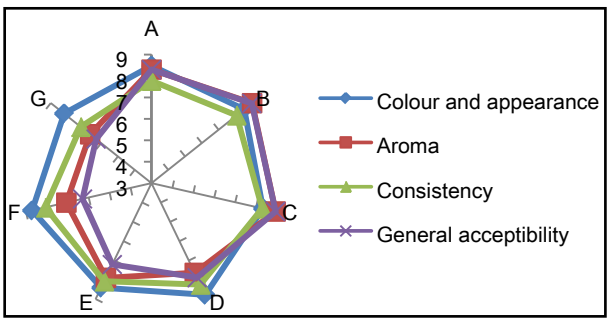
3.3. Sensory Evaluations

The sensory ratings for the APDYs for colour and appearance, consistency, aroma and general acceptability properties are detailed in **Figures 1 (a)-(c)**, respectively. Because of growing yeast and mold, we couldn't make sensorial analysis at 21st day of storage. The results on organoleptic evaluation indicated that the colour and appearance and consistency scores of APDYs with fiber received higher scores than the control samples ($p < 0.01$). It could be related to decrease of whey speration in the samples with fiber. So their appearance was more homogenous than control samples. On the other hand, WHC increased in the samples with fiber and their firmness was improved. As the fiber rates increased the colour and appaerance and consistency scores of the samples increased, except sample G. We think that, addition of oat fiber at the rate of 2% caused too much water binding and concluded the sample G had an appearance and consistency like a yoghurt. Fernandez-Garcia *et al.* [32] reported that fiber addition to unsweetened yogurt improved the body and texture and decreased the quality overall flavour. The colour and appearance and consistency scores of samples decreased during storage. Similar resuls were reported by Sahan *et al.* [19].

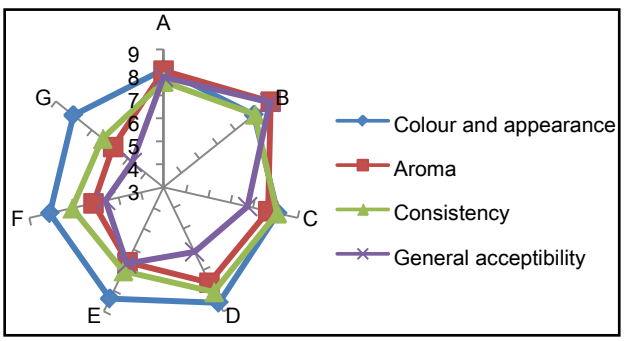
The samples with inulin had the highest and the samples with oat fibers had the lowest aroma scores. Addition of inulin improved the aroma of APDYs. Güven *et al.* [18] had also reported that addition of inulin impoved the aroma of low-fat yoghurt. The panellists declared that flour flavour was feeled in the samples with oat fiber, especially in the samples fortified with 2% oat fiber. Sahan *et al.* [19] reproted that addition of 2% β-glucan influenced sensory scores of yoghurt negatively. Increase in fiber level caused to reduced in aroma scores of the samples. The aroma scores of the all samples



(a)



(b)



(c)

Figure 1. (a) Sensory profiles of the APYD at 1 day of storage; (b) sensory profiles of the APYD at 7 day of storage; (c) sensory profiles of the APYD at 14 day of storage.

increased during storage up to 7 day, and then decreased. At the beginning of storage, APDYs were more intensive flavour. This could be associated with development of acidity and decreases in acetaldehyde contents of the samples at the end of storage. Guven *et al.* [18] and Guler-Akin and Akin [1] reported that the acetaldehyde content was the lowest on day 14 in yogurt.

General acceptability scores of APDYs was influenced negatively by addition of fiber except sample B, which has 0.5% inulin ($p < 0.01$). Sample B had the highest general acceptability scores. Similar results were found by Guven *et al.* [18] in low-fat yoghurt. With increased in fiber level general acceptability scores of the samples decreased. Srisuvor *et al.* [9] reported that high concentration of fiber could negatively affect the product's quality. The general acceptability scores of the samples decreased during storage. Similar results were found Guven *et al.* [18] and Sahan *et al.* [19] in fiber yoghurts.

4. Conclusions

Addition of fiber improved physical properties of APDY such as viscosity and WHC. pH was lower, but titratable acidiy, viscosity and WHC were higher in APDY samples supplemented with oat fiber than the other samples. During the storage, whilst the pH and WHC values declined gradually, the titratable acidity and viscosity content increased at the same time.

While the counts of *S. thermophilus* weren't influenced by fiber, the counts of *L. acidophilus* and *Bifidobacterium* BB-12 were adversely affected by addition of fiber. The counts of *L. acidophilus* and *Bifidobacterium* BB-12 remained higher in APDYs supplemented with oat fiber than the other samples. Higher level of fiber supplementation led to an improvement in viability of *L. acidophilus* and *Bifidobacterium* BB-12. The viability of the probiotic bacteria was the highest in fortified with 2% oat fiber (sample G). During the storage, the viable counts of probiotics and *S. thermophilus* dropped in all samples. However the counts of *L. acidophilus* in all samples fortified with fiber were found to be above the threshold for therapeutic minimum (10^6 - 10^7 cfu g^{-1}).

APDYs supplemented with inulin or oat fiber addition showed different sensory profile. Whilst addition of inulin improved sensory properties of APDYs, addition of oat fiber affected the aroma and general acceptability of APDYs negatively. The sample fortified with 0.5% inulin received the highest sensory scores from the panelists. During storage, total sensory scores of APDYs decreased.

Consequently, the use of inulin and oat fiber in APDY production could be recommended due to theirs prebiotic effects on probiotic bacteria and physical properties in APDYs and the maximum level of them could be 0.5%.

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