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ORIGINAL ARTICLE

Effect of oat flour addition on the physico-chemical and sensory properties of oat added milk drink

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ABSTRACT

Oat was well recognized for their nutritional and health promoting properties. The main purpose of this work was to develop the milk drink with the varying proportion of oat flour and to assess the physico-chemical changes that were occurred due to addition of oat flour in milk. The oat added milk drink was prepared by double toned milk (1.5 % fat and 9.0% SNF), in which different concentrations of oat flour (0, 0.5, 1.0 and 1.5 %) were added along with fixed level of sugar (7%). Addition of oat flour significantly increased the fat, protein, total carbohydrates, ash and total solids with an increased level of oat flour. The viscosity and specific gravity were also significantly increased with the addition of oat flour. In the sensory attributes, the control sample had scored lowest scores for all the sensory attributes of the oat added milk drink. The T_3 had obtained sensory score of 7.73, 7.88, 7.84, 7.90 and 7.84 for colour and appearance, flavour, mouthfeel, sweetness and overall acceptability respectively in fresh conditions. It has been observed that the treatment T_2 i.e. the product contains 1.0 % oat flour was found to be more acceptable than other treatments because its mouthfeel was found better than other treatments.

Keywords: Oat, β-glucan, prebiotics, physico-chemical, sensory attributes, milk drink.

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INTRODUCTION

Now a day's people are becoming health conscious and moving towards foods which gives health and nutritional benefits with good taste. Milk and milk products can be important in diversifying the diet. In the present scenario, with the increasing interest of consumers towards nutraceuticals and functional foods, there is a limited number of presence of fortified milk products containing bioactive compounds. Milk based beverages are becoming popular due to its easy availability, high nutrition, higher palatability and convenience can act as an ideal vehicles for delivery of bioactive compounds [3, 14].

Oats unlike other cereals have received considerable interest due to the presence of soluble and insoluble fibres such as β-glucan, arabinoxylans and cellulose, in addition to relatively high levels of protein, lipids (unsaturated fatty acids), vitamins, antioxidants and phenolic compounds. Oats ("jau" or "jai" in hindi) are the seeds of the plant *Avenasativa*, a minor and cool season crop that has been used as a foodstuff for both humans and livestock for millennia. It is among the valuable functional crops with numerous nutritional, industrial and health benefits. It is an excellent source of dietary fiber β-glucan and are easily available food source that are incorporated into the diet. Several workers had reported that oat groats and oat bran can be used as an alternative food for persons suffering from celiac disease as it does not contain any gluten [6, 16].

Oat has also been used in the preparation of different types of oat based products like oat flakes, pastes, bakery products, beverages etc. several breakfast cereals and bread products are also made from oat flour

and rolled oat products. It also helps in controlling the texture of various food products and have been used as a fat replacers in dairy, meat, and bakery products [7]. Another use of oats has been is in the dairy industry as an antioxidant and stabilizer in ice cream and other dairy products. Many workers used oat β–glucan in the manufacture of cheddar and white-brined cheeses [19]**.** Oat β–glucan due to its thickening and/or gelling properties is used in the food industry [9]; it may also influence the sensory quality of beverages. Plant cell walls and cell-wall polysaccharides: structures, properties and uses in food products

MATERIAL AND METHODS

Preparation of oat added milk drink: The oat added milk drink was prepared from fully pasteurized and homogenized milk with 1.5 % fat and 9 % SNF. In the pre-heated milk (35-45^{0}C), the sugar was added @ 7 % w/v and oat flour were added in different concentrations (0.5%, 1.0% and 1.5%) and control sample was prepared without addition of oat flour. Then the mixture was preheated to 71^{0}C for 15 min. Then filtration was done to remove the insoluble portion of oats. Sterilization was carried out in the glass bottles at 121^{o}C for 15 min. After sterilization, the milk drink was cooled at room temperature and stored at refrigerated temperature.

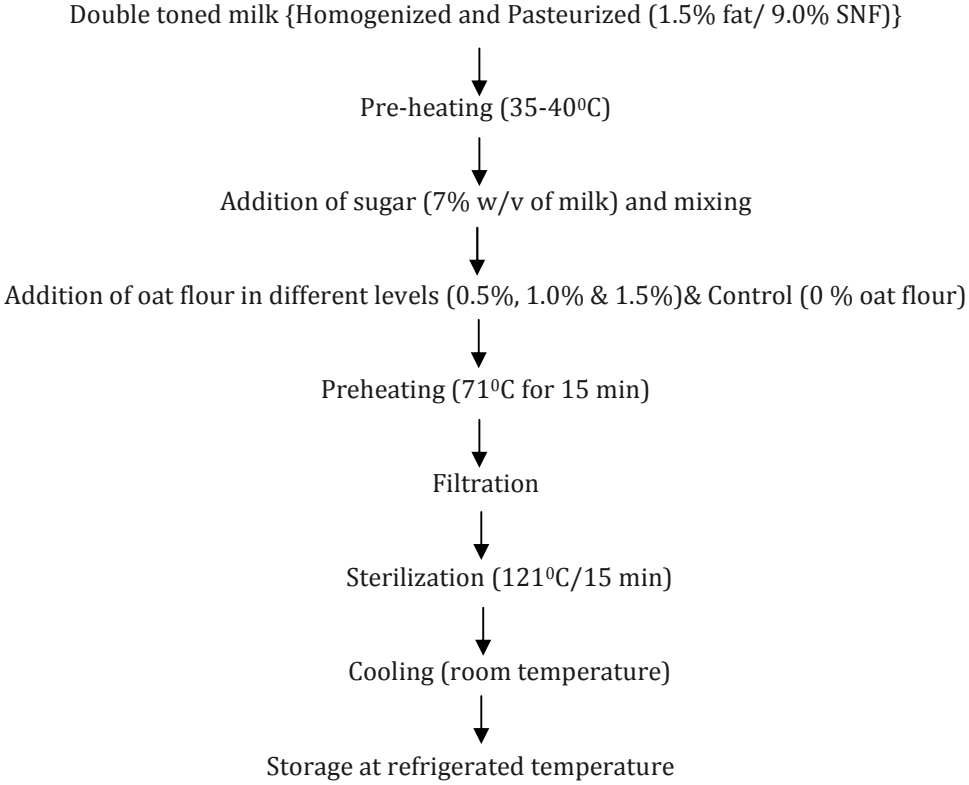

Fig.1: Flow diagram for preparation of oat added milk drink

Physico-chemical analysis:

In the physico-chemical analysis, the fat, protein, ash, total carbohydrates, total solids, viscosity and specific gravity were estimated with the help of standard procedures.

Sensory evaluation of fresh oat added milk drink:

Sensory evaluation of control and experimental samples of oat added milk drink were organoleptically evaluated as per 9 point Hedonic scale as suggested by Lim, [20].

Statistical analysis

In order to study the effect of different levels of oat flour addition on different characters of oat added milk drink, the data regarding physico-chemical quality of oat added milk drink, a laboratory experiment was conducted and desired data were collected. Analysis of variance of these data was worked out on the basis of Completely Randomized Design.

RESULTS AND DISCUSSION

Effect of addition of oat on the physico-chemical properties of oat added milk drink

The observations of the addition of oat flour on the physico-chemical quality of the fresh oat added milk drink is displayed in Table 1.

Table 1: Physico-chemical quality of oat added milk drink

T	Per cent					Sp. gr.	Viscosity (cp)
	Fat	**Prot**	**TCH**	**TS**	**Ash**		
T_0	1.4^{A}	2.99^{A}	11.88^{A}	17.04^{A}	0.770^{A}	1.055^{A}	1.92^{A}
T_1	1.43^{AB}	3.06^{B}	12.01^{B}	17.28^{B}	0.781^{B}	1.058^{B}	2.94^{B}
T_2	1.48^{BC}	3.14^{C}	12.12^{C}	17.53^{C}	0.789^{B}	1.061^{C}	4.63^{C}
T_3	1.5^{C}	3.19^{D}	12.35^{D}	17.84^{D}	0.799^{C}	1.066^{D}	6.04^{D}
CD (5 %)	0.05	0.03	0.052	0.015	0.01	0.001	0.04

Note: TS- Total solids, TCH- Total carbohydrates, NS- Non-significant

The physico-chemical parameters of oat added milk drink with varying oat flour levels (0.5%, 1% and 1.5%) are presented in Table 1. The fat content of oat added milk drink was significantly increased from 1.4 % to 1.5 % with an increase in the concentration of oat flour due to the presence of lipids in the oats. Ramanathan and Sivakumar, [12] reported for gradual increase in the fat content of probiotic dahi enriched with oats with an increase in the concentration of oat flour. The protein content was also significantly ($p<0.05$) increased from 2.99 % in T_0 to 3.19 % in T_3 of milk drink samples. Oats are the rich source of protein (16 %) which was responsible for significant increase of protein content in the oat added milk drink. Similar results was shown by Mohamed *et al*., [12] for increase in the protein content of cheese with an increase in the concentration of oat flour.

Oats contains higher amount of carbohydrate content. The total carbohydrate (TCH) content in the milk drink samples ranged from 11.88 % (T_0) to 12.35 % (T_3).The total carbohydrate content in the oat added milk drink samples constitutes of milk carbohydrate (lactose), sugar and carbohydrate present in oat flour. The increase in the TCH content ofoat added milk drinks can be attributed to varying levels of oat flour in milk drink which was rather the major variable contributor to the total carbohydrate content, sugar being constant for all samples. Mohamed *et al*., (2011) also reported that the addition of increased level of oat flour in the preparation of cheese resulted in significant increase in the carbohydrate content.

The increase in the total solids (TS) content in the experimental samples T_1(17.28%), T_2 (17.53%) and T_3 (17.84%) could be associated with the increased level of oat flour addition. The total solids in the oat added milk drink samples depends upon different factors such as the type of milk used for the preparation of the milk drink, the concentration of sugar and the other additives that were added in the preparation of the product. The similar result was found by Mahrous *et al*., [10] when they prepared synbiotic yoghurt by adding oat flour and reported for an increase in the total solids content in the product.

The addition of oat flour significantly increased ($p<0.05$) the specific gravity of oat added milk drink samples from 1.055 in control sample to 1.066 in milk drink with 1.5 % oat flour. Oat flour contains high percentage of total solids which contributed in increasing the specific gravity of the milk drink with an increase in the concentration of oat flour. Mittal and Bajwa, [11] reported that the specific gravity of low calorie milk drink was increased with an increase in the concentration of inulin.

The addition of oat flour significantly increased ($p<0.05$) the viscosity of oat added milk drinks. The viscosity of milk drink samples ranged from 1.92, 2.94, 4.63 and 6.04 cp for T_0, T_1, T_2 and T_3 respectively. Oat contains high percentage of starch, which during heating process plays a major role in the viscoelastic and rheological properties of any food products. Oat starches undergone changes in the granule structure when heated. During heating process, the gelatinization of oat starches takes place which was responsible for the increased viscosity of milk drink. The amylose and amylopectin from oat starches granules were co-leached at 95^0C [5]. The leaching of amylose and amylopectin was responsible for increase in the viscosity of oat added milk drink. Tesfaye, [18] in his study reported that the oat flour have the ability to increase the viscosity of aqueous solutions and that may results in increasing the palatability of the product. Papageorgiou *et al*., [13] and Lyly *et al*., [9] in their studies had been reported that the oat causes an increase in the viscosity of the solutions thus providing the desired consistency and mouthfeel in the product.

Effect of oat flour addition on the sensory quality of oat added milk drink

The effect of addition of oat flour on the sensory characteristics like colour and appearance, flavour, sweetness, mouthfeel and overall acceptability of oat added milk drink were evaluated on a 9-point Hedonic scale by a panel of 5 judges and the data are presented in the Table 2.

Table 2 Average sensory scores of oat added milk drink at different level of oat flour

Treatment	Sensory characteristics				
	Colour and Appearance	**Flavour**	**Sweetness**	**Mouthfeel**	**Overall acceptability**
T_0	7.62	7.46^A	7.85	7.52^A	7.61^A
T_1	7.65	7.61^B	7.87	7.74^B	7.72^B
T_2	7.69	7.77^C	7.88	7.97^C	7.83^C
T_3	7.73	7.88^C	7.90	7.84^D	7.84^C
CD (5 %)	0.00	0.09	0.00	0.05	0.07

The Table 2 shows the colour and appearance scores of oat added milk drink samples. The colour and appearance score for milk drink samples T_0, T_1, T_2 and T_3were 7.62, 7.65, 7.69 and 7.73 respectively. Statistically there was found non-significant difference among the control and experimental samples of milk drinks for colour and appearance scores. The Ramanathan and Sivakumar, [15] and Mahrous *et al*., [10] reported for increased score of colour and appearance in dahi and yoghurt respectively.

The flavour scores of oat added milk drink samples were significantly increased ($p<0.05$) from7.46, 7.61, 7.77 and 7.88for T_0, T_1, T_2 and T_3respectively (Table 2). The oat added milk drink with 1.5 % oat flour (T_3) had obtained highest score for flavour as compared to other experimental and control samples.The flavour scores in the milk drink samples were increased which may be due to the complex collection of volatile flavour components in oat flour [17]. Mahrous *et al*., [10] reported that with an increase in the concentration oat flour, the scores for flavour in yoghurt increased. Tesfaye, [18] reported that the addition of oat flour improved the flavour scores in the yoghurt than control sample (without oat flour).

The Table 2 shows the effect of oat flour addition on mouthfeel of different samples of oat added milk drink. The experimental samples T_1, T_2 and T_3 of oat added milk drink had scored 7.74, 7.97 and 7.84 respectively for mouthfeel attributes. The score of mouthfeel in all the samples of oat added milk drink had significant ($p<0.05$) difference with all the concentrations of oat flour. The addition of oat flour in the milk drink had provided desired consistency and mouthfeel in the oat added milk drink samples. Oat contains fiber which contributes in improving the mouthfeel of the product. The sample T_3 of oat added milk drink had obtained less score than T_2 because it contains 1.5 % oat flour which resulted in more viscous product and minimized the degree of mouthfeel in the product. The result obtained from this work indicated that the addition of oat flour above 1.0 % concentration may produce somewhat highly viscous products which ultimately results in the development of the milk drink which lacks in the drinkable consistency. Mahrous *et al*., [10] prepared synbiotic **y**oghurt by adding different concentrations of oat flour and reported that the addition of oat flour had improved the score for mouthfeel in the product. Chatterjee and Patel, [4] also reported the improved scores for mouthfeel in chocolate flavoured milk when added with oat β-glucan. Addition of oat soluble fiber β-glucan into low-fat dairy products, can improve their mouthfeel as well as other sensory properties to more closely resemble full-fat products [1].

The sweetness scores obtained for samples T_0, T_1, T_2 and T_3 were 7.85, 7.87, 7.88 and 7.90respectively inoat added milk drink. No significant difference was observed among the samples of oat added milk drink. Chatterjee and Patel, [4] found almost same scores for sweetness in oat β-glucan chocolate flavoured milk and control. On the contrary, Ramanathan and Sivakumar, [15] reported that the addition of oat flour in dahi improved the sweetness score of the product. Kale *et al*., [8] reported that the addition of oat flour in the preparation of value added dahi (VAD) had obtained highest score for sweetness attribute.

The overall acceptability scores was significantly increased for samples T_0, T_1, T_2 and T_3 were 7.61, 7.72, 7.83 and 7.84 respectively in oat added milk drink (Table 2).The level of addition of oat flour had considerable effect on overall acceptability scores of oat added milk drinks. The results of this findings were similar to the study of Chatterjee and Patel, [4] in which they reported that the chocolate flavoured milk with oat β-glucan improved that overall acceptability of the flavoured milk. Brennan and Tudorica, [2] prepared yoghurt by adding oat and reported that the addition of oat caused to improve the overall acceptability of the yoghurt.

CONCLUSION

In the present work, the oat added milk drink was prepared by addition of oat flour and sugar in milk. The addition of oat flour significantly increased the fat, protein, ash, total carbohydrates (TCH) and total solids (TS) content in all the experimental samples. The addition of oat flour had significantly increased

the viscosity as well as specific gravity with an increase in the concentration of oat flour. In the sensory attributes, the sample T_3 had obtained highest sensory scores of 7.73, 7.88 and 7.90 for colour and appearance, flavour and sweetness respectively but T_2 had obtained highest score of 7.97 for mouthfeel, while T_0 had lowest values for colour and appearance, flavour, mouthfeel, sweetness and overall acceptability. It can be concluded that the sample T_2 was found more acceptable from rest of the samples as it had obtained highest scores for mouthfeel, a product can be acceptable even with uneven colour and flavour but it can only be acceptable with desired consistency and mouthfeel.

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