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Studies on quality evaluation of OAT milk

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Abstract
Plant based milk has been on a rise in the Indian as well as international markets. Factors such as lactose intolerance, calorie concern, increasing use of growth hormones in animal milk and increasing population have led to the development of plant based milk. Many such plant based milk include oat milk, coconut milk, peanut milk, rice milk, soy milk etc. In the present study, rolled oats were used for the extraction of oat milk. Prior to the extraction of milk, the rolled oats were subjected to soaking and the ideal duration of soaking was determined. The slurry obtained was then subjected to an enzymatic treatment. The slurry was filtered and stabilizer and flavoring was added. After the standardization, the physical and chemical evaluation of the developed oat milk was carried out.

Keywords: Plant milk, lactose intolerance, oats, enzymatic treatment

Introduction
The oats belongs to the family of *Poaceae* and is commonly known as *Avena sativa*. Oats are generally regarded as a minor cereal crop when considered in terms of grain produced annually, or areas sown for production (Wani *et al*. UJP 2014) [12].
Health benefits of oats are associated with dietary fibres such as β-glucan, functional protein, lipid and starch components and phytochemicals present in the oat grain and that is why it is one of the promising raw materials for preparation of functional plant-based milk. Oats are good source of quality protein with good amino acid balance. The interest in oats is mainly aroused due to the presence of functionally active component, β-glucan which possesses neutraceutical properties. b-glucan, a soluble fibre, has the ability to increase the solution viscosity and can delay gastric emptying time, increases gastrointestinal transit time which are associated with their reduced blood glucose level. (Welch 1995) [14].
Oat is well accepted in human nutrition and it is an excellent source of different β-glucan, arabinoxylans and cellulose (Wani *et al*. UJP 2014) [12].
Soluble fibre of oats has been reported to reduce elevated blood cholesterol, triglyceride, and glucose levels. Oats also good sources of insoluble fibre functions as a water-holding-capacity agent and can reduce intestinal transit time when present in adequate amounts in food (Anderson JW, 1986) [2].
The Food and Drug Administration of the United States of America has recently allowed a health claim for an association between consumption of diet which are high in oat meal, oat bran, or oat flour and has reduced the risk of coronary heart disease. This represents the first health claim for a specific food under the Nutrition Labelling and Education Act (1990) and follows on the long history of investigation and controversy. The claim is based on the many clinical studies that concluded oat products may reduce serum cholesterol levels, a treat in coronary heart disease (Wood *et al*, 1998) [15].
Accordingly, the FDA has acknowledged nutritional claims that the use of dietary fibres (including oat β -glucan material) reduces the glycaemic and cholesterol responses of individuals. Current recommendations suggest an intake of 20-40 g of dietary fibre per day (DeVries *et al*, 2001) [6].
Oat milk is the recent emergent in the market owing to its potential therapeutic benefits. Oats have received extensive interest due to the presence of dietary fibers, phytochemicals and high nutritive value. Health benefits of oats are associated with dietary fibers such as β-glucan, functional protein, lipid ans starch components and phytochemicals present in the oat grain and that is why it is one of the promising raw materials for preparation of functional plant-based milk (Swati Sethi *et al*, 2016) [11].
Several products containing fibre are offered to the market such as "Oat Milk"® (Frolich 1996, Onning 1998) [7, 8], the Swedish company Probi AB produces the product "Pro Viva"® from an oat meal fermented with Lactobacillus plantarum (Bekers *et al*) [5].
Commercially, oat milk is available under brand names Oatly (Sweden), Pureharvest

(Australia), Alpro (UK), Bioavena drink (Italy), Simpli (Finland), Pacific (USA) etc. The milk is available in convenient tetra packs of various sizes and is UHT treated (Swati Sethi *et al*, 2016) [11].

Materials and Method

Oats used for the study were rolled oats from the company 'True Elements'. These are lightly processed whole oats. They are made from oat groats that have been dehusked and steamed, before rolling and light toasting. Food grade α-amylase was obtained from the college laboratory.

Preparation of oat milk

The processing of oat milk was based on preliminary experiments. The variations adopted was on the duration of soaking. Three different durations for soaking were adopted i.e. for 1hr, 6hrs and 8hrs. Oat milk was prepared according to enzymatic method described by Deswal *et al*, 2014. The ratio of oats to water for soaking was 1:2.7. The soaked oats were ground in a mixer grinder. The slurry was treated with an enzyme concentration of 77.78 mg/kg of rolled oats for liquefaction for 49 min at 75°C. The prepared milk was filtered using a nut milk bag. After the enzymatic treatment, inactivation of the enzyme was carried out by heating the oat milk over 100°C for 5 mins. A few drops of vanilla essence were added after cooling of the oat milk.

Physico-chemical analysis of oat milk

Following physico-chemical properties of oat milk were determined.

Titratable acidity and pH

Titratable acidity was expressed as percent acid present, determined by titration against 0.1 N phenolphthalein as an end point indicator. The pH value was obtained by using a digital pH meter (ELICO LI612) after standardizing with buffers (Ranganna S. 1991) [9].

Viscosity

Viscosity was determined using the Brookfield viscometer DV-E. Viscosity was expressed in terms of centipoises (cP) (Weaver and Daniel, 2005) [13].

Nutrient analysis of oat milk

AOAC protocols were used in determining the proteins, fats. Estimation of β-glucan was carried out by following the assay procedure K-BGLU 06/11 – Megazyme kit 2011.

Microbial analysis of oat milk

Ten milliliters of the oat milk sample was thoroughly mixed in 90 mL sterile distilled water to obtain 10^{-1} dilution, from which further dilutions were made. Viable counts (Total plate count, yeast and mold count) present in the extracted oats milk sample were determined. The counts were expressed in logarithmic of colony-forming unit per mL/g of sample (log CFU/mL/g).

Results and Discussion

Physico-chemical analysis of oat milk

From the results it was observed that oats soaked for a duration of 8hrs obtained the most satisfactory yield of 320.4 ml. It did not produce sliminess and maintained efficient blending and mixing properties. The results pertaining to the yield of the oat milk with respect to the soaking duration are given in the table (1).

The oat milk with 8hrs of soaking duration was further used to carry out the physico-chemical and nutritional analysis. The pH of the oat milk was 5.92, whereas the titratable acidity was 0.45%. The viscosity of milk as expressed in centipoise was 3.5 cP. The physical and chemical properties of the oat milk are given in table (2).

Nutritional profile of oat milk

The nutritional analysis of the oat milk was carried out to indicate the carbohydrate content as 34.03%, protein as 0.966%, %fat as 0.36%. The dietary fibers were estimated to be around 3.2% whereas the beta glucan content was 0.54%. The results of the nutrient analysis are indicated in table (3).

Microbial analysis of the oat milk

The growth of undesirable microorganisms into any product may lead to contamination, growth and production of food borne diseases which may cause hazardous effects on healthy individuals. Therefore, carrying out microbial analysis of foods before consumption is of prime importance so that they are safe for consumption. The data obtained after the microbial analysis of the oat milk is given in table (4).

Effect of various stabilizers on the stability of oat milk

The standardized oat milk was treated with various stabilizers like gum arabic, guar gum, xanthan gum and sodium alginate. 0.5% of guar gum was incorporated into the oat milk which resulted in a homogenous oat milk with no sedimentation at storage.

Table 1: Yield analysis of oat milk depending upon soaking duration

Sr. No.	Parameters	1 hour	6 hours	8 hours
1.	Yield	290.2	310.8	320.4
2.	pH	5.673	5.857	5.923
3.	Titratable acidity	0.38	0.41	0.45

Table 2: Physical parameters of oat milk after soaking the oats for 8 hrs

Sr. No.	Parameters	Observations
1.	pH	5.92
2.	Titratable acidity (%)	0.45
3.	Viscosity (cP)	3.5

Table 3: Nutritional analysis of oat milk

Sr. No.	Parameters (%)	Observations
1.	Carbohydrates	34.03
2.	Proteins	0.966
3.	Fats	0.36
4.	Dietary fiber	3.2
5.	β glucan	0.54

Table 4: Microbial analysis of oat milk

Sr. No.	Parameters (CFU/ml)	Observations
1.	Total Plate Count	400
2.	Yeast and Mold Count	125

Conclusion

In the present investigation, efforts were made to develop oat milk with different durations of soaking periodsd. The study revealed that, 8hrs of soaking was found to be optimum for extraction of the milk. The milk was given an enzymatic treatment after which it was filtered and the enzyme was inactivated by heating. Stabilizer and flavor was added to improve its acceptability.

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