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Change in color & appearance of β-Glucan fortified instantinized RTS milk beverage powder

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Abstract
β-Glucan is a soluble dietary fibre and imparts viscosity to the meals. The incorporation of β-Glucan in milk causes instability of the milk protein and leads to phase separation. Spray drying is the process of contacting an atomized stream to be dried with a gas stream that is at a higher temperature than the liquid stream. The higher temperature of the gas stream causes evaporation of the liquid from the droplets, forming particles. Spray drying has been used extensively in the food industry for example the manufacture of milk powder. This study was done to formulate a ready to serve milk beverage powder and observe the change over a storage period of 180days at four different temperatures, i.e. 10ºC, 25ºC, 37ºC and 45ºC. The highest score was obtained for the sample stored at 10ºC followed by 25ºC.

Keywords: β-Glucan, sensory, spray drying, temperature

Introduction

β-Glucan is structural polysaccharide found abundantly in the cell wall of endosperm and aleurone layers of oat, barley, wheat and rye (Charles and Louise, 2005; Lazaridou *et al*., 2008) [1, 4]. It is naturally present in the cereal grains and fungal mass and possess biological response modifiers that are physiologically active compounds (Vetvicka and Vetvickova, 2017) [15]. β-Glucans are heterogenous group linked by glycosidic bond, i.e. (1-3)- β, (1-4)- β or (1-6) β (Stier *et al*., 2014) [11]. Chemically, chain of β-Glucan is with repeating glucose residues in either linear form or multiple branched structures (Lam and Cheung, 2013) [5]. It may form large cylindrical molecules which contains upto 250,000 glucose units (Vannucci *et al*., 2013) [17].

Now-a-days, owing to the benefits of β-Glucan, it is being commercialized on a large scale. Recent commercialization that has been done of β-Glucan are- ceapro from oat (Morgan and Ofman, 1998; Tomasik and Tomasik, 2003) [8, 14], betamune from yeast (Vetvicka *et al*., 2008) [16] and glucagel from barley (Morgan and Ofman, 1998) [8].

Spray drying processes have a wide variety of applications in industries from the manufacture of food to pharmaceuticals and more recently hollow polymeric microparticles. In spite of the wide uses of the spray drying process the approach to the design of the spray dryer has remained experiential. One reason for this is that the spray drying process itself exhibits certain characteristics, such as rapid heat and mass transfer and a distributed nature, that are challenging from a first principles modeling perspective. Additionally, the control of these processes is difficult since direct on-line realtime measurements of the product quality (e.g., particle size) are not available (Shabde, 2006) [12].

In the spray drying process, a liquid spray is brought into contact with a heating gas to evaporate the solvent present in the solution. The product is in particle form. The contact between the heating gas and liquid spray may be achieved in either a co-current or a counter-current manner. In the design of the spray dryer, the residence time of individual particles inside the spray dryer is important. A particle should remain in the spray dryer long enough for complete evaporation of the solvent but not too long to cause product degradation, e.g., by charring.

Spray drying is the process of contacting an atomized stream to be dried with a gas stream that is at a higher temperature than the liquid stream. The higher temperature of the gas stream causes evaporation of the liquid from the droplets, forming particles. Spray drying has been used extensively in the food industry for example the manufacture of milk powder; the pharmaceutical industry to form powders for pelletization (Fletcher *et al*., 2003; Maa and Prestrelski, 2000) [13, 7] and the agricultural industry to produce different granular materials, to name a few examples. Recently, the use of this process to manufacture hollow, micron and sub-micron particles has also been demonstrated (Shabde *et al*., 2005; Narayan *et al*., 2001) [13, 12]. There is still lack of research about incorporating dietary fibre into milk beverages.

Therefore, this research was planned to study the fortification of β-Glucan and its stability in the milk beverage along with its sensory acceptability.

2. Materials and Methods

The present work was carried out in the laboratory of Department of Animal Husbandry & Dairying, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India.

2.1 Production of β-Glucan fortified instantinized ready to serve milk beverage powder

Feed solution was prepared according to the methodology given by (Singh and Pandey, 2018) [10]. Jay Scientific Spray-drier was used in this experiment. β-Glucan fortified instantinized ready to serve milk beverage powder was prepared by using Lab scale spray drier.

2.2 Change in color and appearance of β-Glucan fortified instantinized ready to serve milk beverage powder

The change in color and appearance of the formulated β-Glucan fortified instantinized RTS milk beverage powder was carried out on the basis of sensory analysis by a semi-trained panel of 9 judges including the members from staff and students of the Department of Animal Husbandry & Dairying at Banaras Hindu University, Varanasi, India (Rathor *et al*., 2016) [10]. The results were taken on hedonic scale ranging from 1 to 9, where 1 represents dislike extremely and 9 represents like extremely (Lawless and Hayman, 1998) [6].

2.3 Statistical analysis

Significant test for the said experiment was done by using Statistical Package for Social Sciences (SPSS) version 23.

3. Result and Discussion

3.1 Sensory evaluation of β-Glucan fortified instantinized ready to serve milk beverage powder

Table 1 depicts the data for change in color and appearance of β-Glucan fortified RTS milk beverage powder. Statistical analysis of sensory scores indicated that the change in color and appearance under study varied significantly ($p<0.05$) in the sample. Highest overall acceptability with highest score was found in sample kept at 0day. The samples stored at 10ºC and 25ºC remained acceptable till 180days, but for sample stored at 37ºC and 45ºC a much more decrease was observed at the end of 180 days. Highest deterioration was found in sample stored at 45ºC. Chauhan and Patil (2013) [2] also found the same observations in case of mango milk powder.

Table 1: Change in color and appearance of β-Glucan fortified in stantinized RTS milk beverage powder

Days	**β-Glucan fortified instantinized RTS milk beverage powder**			
	10ºC	**25ºC**	**37ºC**	**45ºC**
0	8.83 ±0.15	8.83 ±0.15	8.83 ±0.15	8.83 ±0.15
30	8.60 ±0.26^{c}	8.16±0.1^{bc}	7.7±0.52^{ab}	7.16±0.37^{a}
60	8.43 ±0.20^{c}	8.03±0.40^{bc}	7.30±0.62 ^{ab}	6.73±0.15^{a}
90	8.00 ±0.45^{b}	7.73±0.51^{ab}	7.03±0.61 ^{ab}	6.86±0.47^{a}
120	7.90 ±0.30^{c}	7.33±0.15^{bc}	6.73±0.40 ^{ab}	6.06±0.61^{a}
150	7.33 ±0.15^{b}	6.76±0.35^{b}	6.03±0.20^{a}	5.76±0.60^{c}
180	6.63 ±0.15^{c}	6.13±0.25^{bc}	5.66±0.41^{ab}	5.06±0.56^{a}

Data is represented as Mean±Std. Deviation

Values represented in superscripts are differing significantly at $p<0.05$

Conclusion

Therefore, it is concluded that storage of β-Glucan fortified RTS milk beverage powder at higher temperature is not suitable for a longer period of time; i.e. its quality gets degraded; whereas at a lower temperature product maintains its color and appearance.

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