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RESEARCH PAPER

Nutritional composition of powder of Hassan breed sheep milk using spray dryer and freeze dryer

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Abstract : Sheep rearing in India is carrying out with only interest of meat production and given least importance to the milk production. In order enhance the usage of sheep milk or sheep milk powder still it is required create more awareness about its advantages and health benefit characteristics. With this point, this work has been carried out and found the nutritional composition of the sheep milk of Hassan breed by using spray dryer and freeze dryer.

Key Words : Chlorophyll content, Relative water content, Chlorophyll stability index, Proline yield, Water stress

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INTRODUCTION

Sheep milk production by the 20 main producing countries was estimated at 8.3 billion tons in 2012, while bovine milk production was estimated at 458 billion tons in the same period (2). There are differences in physical-chemical characteristics between cow and sheep milk. Sheep milk has higher specific gravity, viscosity, refractive index, titratable acidity, and lower freezing point (6) and contains higher total solids and greater nutrient contents than cow milk.

Milk is one of the most nutritionally complete foods available on the food markets to date. It is naturally a good provider of a whole range of nutrients essential to growth, developments and maintenance of the human body (Cannon, 1992).

Zouari *et al.* (2020b) said that spray drying is mainly utilized for producing powders of milk and milk products, owing to rapid removal of moisture from atomized milk droplets by hot air, continuous operation, flexibility in handling variety of feeds and above all economic operation. However, spray drying is a high temperature process and reduces the heat sensitive nutritional components significantly (Habtegebriel *et al*., 2018).

Freeze drying, also termed as lyophilization or cryodesiccation, is a sophisticated dehydration process involving three steps *i.e.*freezing, sublimation and desorption. Freeze drying, being a low temperature operation, offers attractive advantages for dairy products such as higher retention of heat sensitive vitamins, prevention of whey protein denaturation and maillard

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reaction, shelf-stable product with low moisture, rigid and porous structure (Ibrahim and Khalifa, 2015).

Freeze-drying is based on the dehydration by sublimation of a frozen product. During this process, the low temperature and the absence of liquid water and oxygen minimize the thermal and chemical degradation of final products. Thus, the freeze- drying process is regarded as an excellent dehydration process for heat sensitive products. In spite of the benefits mentioned above, it is well known that the process has been recognized as the most expensive process for manufacturing a dehydrated product (Boss *et al.,* 2004, Tsinontides *et al.,* 2004; Carvalho *et al.,* 2007 and Rogers *et al.,* 2008).

Owing to its expensive and time-consuming nature, freeze drying finds its application in dairy sector for selected niche products, encapsulation of functional constituents such as probiotics and preservation of starter culture (Bhushani and Anandharamakrishnan, 2017).

In spite of the processing efficiency (e.g., low temperature) of freeze-drying for making milk powder products, little study has been conducted to produce freeze-dried milk powder. Non-heat treatment during freeze-drying could improve the quality of the final milk powder products (Song-Hee Kim *et al.,* 2010).

MATERIAL AND METHODS

Brief explanation about methods used in present work.

Selection of fresh sheep milk :

Fresh sheep milk was procured from the different places of Karnataka. Prior to milking, the teats of all milking sheeps were washed with clean water and dried with single service paper towels. After discarding the first few strippings, a representative milk sample was collected. Random milk samples from Sheeps were collected. Fresh raw milk was stored at 5±1 °C before further analysis.

Unit operations involved in production of sheep milk powder :

Unit operations such as preheating, filtration, pasteurization, concentration and drying were carried out in the present research. The unit operations are briefly explained in the following sections.

Preheating :

Preheating was done prior to filtration at a temperature of 35 °C using digital water bath for efficient filtration of sheep milk.

Filtration :

Filtration was done using muslin cloth to remove the unwanted material in the fresh milk.

Pasteurization :

Pasteurization of milk was done to achieve all the particle of sheep milk to at least 72°C for 15 s to inactivate the activity of the micro-organisms which were present in the milk. In the present investigation, the pasteurization process was done using a digital water bath in a batch process. Sheep milk was taken in a stainless steel container and placed in the water bath for pasteurization at the temperature of 72 °C for 15 s (HTST). The desired temperature was measured using thermometer during pasteurization. After pasteurization, the milk was immediately cooled to 5±1 °C in a refrigerator.

Concentration :

Evaporation or concentration by boiling is the partial removal of water from milk by boiling off water vapour. Generally in every milk powder industry, the concentration process is carried out to decrease the drying load, drying time and to reduce the bulk of material to be preserved. In the present investigation, concentration of sheep milk was done using rotary vacuum flash evaporator (Make: ROTEVA Equitron) at a temperature of 60°C until achieved the desired concentration of milk *i.e.*, 35, 40 and 45%.

Spray drying :

Spray drying is a one-step, continuous process, allowing ease of scale-up. It is also useful for the processing of heat-sensitive materials due to very short exposure time of product to heat, which can range in the order of 5 to 10 s. The main factors in spray drying that must be optimized are inlet air temperature, outlet air temperature, feed rate, spray air flow and aspirator flow. Spray drying is a method where the result strongly depends upon the material properties and factors of spray drying in a combined system influencing the product parameters such as temperature load, final humidity, particle size and yield (Patel *et al*., 2009). Spray drying converts liquid form into an engineered powder product in one step. Spray dryer (Make: LSD-48 mini spray dryer:

JISL) is used to carry out the work to produce the powder of sheep milk of Hassan breed.

Freeze drying of Sheep milk of Hassan breed :

Freezing:

After filtration and Pasteurization of sheep milk, freezing of fresh milk was kept in the freezer and the temperature maintained was -20°C prior to keeping the sample in the freeze dryer.

Freeze dryer parameters :

Sheep milk of was transferred to stainless steel holders for freezing in deep freeze refrigerators, then the frozen milk samples were freeze dried using a freeze dryer (Make: DELVAC). When the temperature of collector reached "55 to " 60°C was started for achieving a negative pressure. The powdered freeze dried sample was collected in stainless steel holders after 20 h and stored in metalized laminates for analysis. Freeze dried powder was crushed manually with a glass rod to have uniform powder.

The nutritional composition of sheep milk powder samples, namely moisture content, fat, protein, Carbohydrate, titratable acidity and ash, were determined as follows; The moisture content of sheep milk powder samples were determined by hot air oven (Make: ROTEK) method (No. 990.20; AOAC, 2005). Total solids in Sheep milk powder sample was calculated using following expression; Total solids (%) = 100 - Moisture content (%, d.b.). Fat in sheep milk powder samples were determined by the Gerber method (Method No. 2000.18) given in AOAC (2005). The nitrogen content in sheep milk powder samples were estimated by using Kjeltech instrument (Model: Kelplus-Distyl EMS, Kelplus-KES 12L, Pelican Equipments) by Kjeldahl's method (991.20) of AOAC (2005). The total ash content of sheep milk powder samples were determined at 550 °C for 5 h by muffle furnace (Make: ROTEK) method (AOAC, 2005; Method No.925.23). Titratable Acidity in sheep milk powder samples were determined by the method (No. 947.05) given in AOAC (2005).

RESULTS AND DISCUSSION

Proximate composition of spray dried sheep milk powder of different concentration and temperature combinations were conducted but powder at 40% concentration and 170°C combination given good results and sample was analysed for its nutritional composition

Fig. 1: Spray dryer

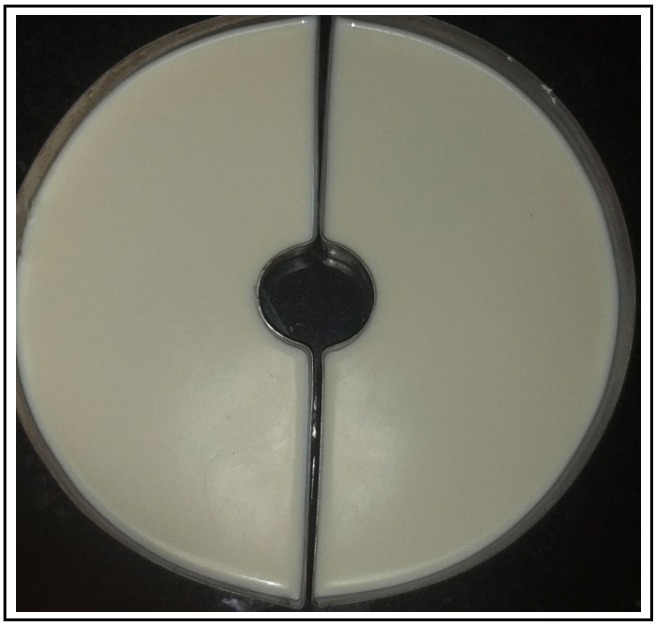

Fig 2: Milk sample holder for freeze drying

Fig 3: Freeze dryer

and values given in Table 1. Nutritional composition of freeze dried sheep milk powder were determined and presented in Table 2. Freeze dried sheep milk powder was estimated and results show that slight increase in the percent of protein and fat and reduction in the ash content comparing to the spray dried sheep milk powder.

Freeze drying, also termed as lyophilization or cryodesiccation, is a sophisticated dehydration process involving three steps *i.e.* freezing, sublimation and desorption. Freeze drying, being a low temperature operation, provides attractive advantages for dairy products such as higher retention of heat sensitive vitamins, prevention of whey protein denaturation and mail lard reaction, shelf-stable product with low moisture, rigid and porous structure (Ibrahim and Khalifa, 2015).

Table 1: Proximate composition of spray dried sheep milk powder

Constituents	Fresh sheep whole milk powder @ 40 % Conc. and Temp 170 °C
Moisture content (%)	3.92
Fat (%)	26.65
Protein (%)	26.34
Carbohydrate (%)	35.95
Ash (%)	7.14
T. A. (%)	0.21

Table 2 : Proximate composition of freeze dried sheep milk powder

Constituents	Fresh sheep whole milk powder
Moisture content (%)	3.60
Fat (%)	27.20
Protein (%)	28.30
Carbohydrate (%)	33.3
Ash (%)	7.60
T. A. (%)	0.17

Conclusion :

The study shows that nutritional composition of the spray drying and freeze drying of sheep milk. As the freeze dryer operates at very low temperature, the powder obtained from the freeze drier gives the better protein and fat retention compare to spray dryer.

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