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Maske TA
Department of Animal Husbandry and Dairy Science, College of Agriculture, Latur, Maharashtra, India

Andhare BC
Department of Animal Husbandry and Dairy Science, College of Agriculture, Latur, Maharashtra, India

Shinde SP
Department of Animal Husbandry and Dairy Science, College of Agriculture, Latur, Maharashtra, India

Shingare JD
Department of Animal Husbandry and Dairy Science, College of Agriculture, Latur, Maharashtra, India

Corresponding Author:
Maske TA
Department of Animal Husbandry and Dairy Science, College of Agriculture, Latur, Maharashtra, India

Standardization of technology for manufacture of paneer from toned milk using sago powder

Maske TA, Andhare BC, Shinde SP and Shingare JD

Abstract
The present study was carried out on "Preparation of Paneer from toned milk using sago powder". The research work was conducted in the laboratory of Department of Animal Husbandry and Dairy Science, College of Agriculture, Latur, V.N.M.K.V., Parbhani during the year 2016-17. Paneer was prepared from different levels of toned milk and sago powder, i.e. (T_1-100 Parts of toned milk), (T_2- 97.50 Parts of toned milk + 2.50 parts of sago powder.) (T_3- 95.00 Parts of toned milk + 5.0 parts of sago powder) And (T_4- 92.50 Parts of toned milk + 7.50 parts of sago powder) added on the weight basis of milk. The temperature level for addition of sago powder was optimized by conducting sensory test for three levels of temperature i.e. at room temperature, at 72 °C and 87 °C on the basis of sensory test recorded for test/ mouth feel only on 9 point hedonic scale by semi expert panel of judges. In all treatments, the maximum score for test/ mouth feel was recorded at 72 °C temperature level which is optimized for preparation of sago Paneer.

Keywords: Paneer, sago powder, toned milk

Introduction
Paneer is a South Asian variety of soft cheese obtained by acid and heat coagulation of milk, entrapping almost all the fat, casein complexed with denatured whey proteins and a portion of salts and lactose. It is a non-fermentative, non-renneted, non-melting and unripened type of *cheese.* India has emerged as the largest milk producer in the world with 132.4 million metric toned milk productions in 2012-13 (15% of the world's total milk) (NCAER, 2012). Out of this, an estimated, 5% of milk produced in India is converted to Paneer (Chandan, 2007) [4]. The estimated market (traditional and organized sectors) of Paneer in 2002-03 was worth Rs. 21 crores and its production was 4,496 MT in 2004 (Joshi, 2007) [7]. Due to the ever growing demand of Paneer by varied health conscious consumers, it is necessary to develop new types and varieties of Paneer.

Paneer is similar to soft cheese and is not only very popular in Indian subcontinent but has also made appearance in Western and Middle East markets. It is marble white, somewhat spongy with mildly acidic favour and is generally prepared from buffalo milk (Patel, 1991) [16]. Paneer is of great value in diet because it is a rich source of high quality proteins, fat, minerals and vitamins (Shrivastava and Goyal, 2007) [15]. It forms base for a variety of culinary dishes, stuffing material for various vegetable dishes, snacks and sweetmeats.

Paneer contains all the milk constituents except for loss of some soluble whey proteins, lactose and minerals (Singh and Kanawjia, 1988) [17]. Paneer has a fairly high level of fat (22-25%) and protein (16-18%) and a low level of lactose (2.0-2.7%) (Kanawjia and Singh, 1996). Paneer contains 70% moisture. Paneer must be uniform and have a pleasing white appearance with a greenish tinge when made from buffalo milk and light yellow when made from cow milk.

Paneer is an indigenous coagulated milk product prepared by addition of organic acid to milk at higher temperature followed by pressing of the coagulum. This product is extensively used as an ingredient for preparing cooked meat and vegetable dishes in North West Frontier Province (N.W.F.P.) of Pakistan (Athar *et al.* 1989) [18]. This Paneer product is mostly prepared from buffalo milk, because it contains higher level of casein and minerals (calcium and phosphorous) which helps to produce Paneer with hard and rubbery body. So technologist claimed that buffalo milk can be utilized for preparation of high grade Paneer. In the present investigation an attempt was made to compare the quality and quantity of Paneer prepared from buffalo and cow milk by using known strength of coagulant at a particular temperature.

Low fat Paneer generally, health conscious people do not like to consume conventional Paneer because of its high fat content.

Therefore, efforts have been made to develop low fat Paneer without significantly compromising the sensory and textural characteristics. Good quality low fat Paneer has been developed at National Dairy Research Institute, Karnal from milk having as low as 3.0% fat (Kanawjia and Khurana, 2006) [9]. Kanawjia and Singh (2000) [19] reported that fortification of low fat milk with soya solids improved its rheological and sensory quality along with reduction in the cost of production. Chandan (2007) [4] reported that skim milk Paneer and low fat Paneer having 13 percent and 24 percent fat, respectively on dry matter basis are available in the Western countries. Out of these, former had a chewy, rubbery texture and hard body. Appropriate technology has been developed for the manufacture of acceptable quality Paneer from whole milk powder and also from skim milk powder and butter oil (Kanawjia and Khurana, 2006) [9].

Dietary fiber enriched low fat Paneer with increase in the awareness about the health risks associated with consumption of dietary fat and cholesterol intake, there is an increase in the demand of fiber enriched low fat or non fat food products. Since Paneer prepared from low fat milk result in hard body, coarse, rubbery and chewy texture, bland flavor, poor mouth feel as well as mottled colour and appearance (Chawla *et al*. 1985) [5], low fat Paneer with an improved quality in terms of sensory, rheological and nutritional attributes has been developed by using soy fiber and inulin (Kanawjia and Khurana, 2006) [9]. These fibers besides improving the texture and sensory properties of low fat Paneer, improves the bowel movement and reduces the chances for colorectal cancer.

Tapioca sago is generally known as SAGO (SABUDANA in Hindi or Javarishi in Tamil) in India. Sago is a produce, prepared from the milk of 'Tapioca root'. Its botanical name is "Manihot Esculentacrantz Syn. Utilissima" It's have a several name in the various regions where it is consumed. It is known as Yuca, Rumu or Manioca in Latin America, Manioc in French speaking Africa and Madagascar Cassava in English speaking (Flach *et al*. 1996) [6]. Research by Ahmad and William (1998) [1] found that sago starch contains 27% of amylase with 30 um of its particle size. Sago's gelatinization temperature range is similar to corn starch while its hot paste properties are almost the same as potato starch.

Tapioca was introduced in India during the latter part of the 19th century. Now, mainly grown in the states of Kerala, Andhra Pradesh and Tamil Nadu. Products from tapioca like starch and sago introduced in India only in 1940s upwards. Currently, the Tamil Nadu state stands first in respect of processing of tapioca into starch and sago powder in India.

Sago powder is the starch and starch included in the hydrocolloids. Hydrocolloids are the substance which dissolve or disperse in water to give a thickening or gelling effect. The use of hydrocolloids as food modifiers has become an accepted practice in the food industry. The hydrocolloid used in food products provides shape, form, texture and functionality to the product. The hydrocolloids have also been widely used in milk and milk products for improving textural quality and the sensory characteristics of the final product. In coagulated milk product such as cheese, chhana, Paneer, hydrocolloids have been used to improve the body and texture of the finished product and to reduce the loss of solids in whey (Bhadekar, 2003) [3].

Sago grains are about 2 mm in diameter. They are a source of pure carbohydrates with very little protein, vitamin 'C' and minerals, a 100 gm of dried sago yields about 355 calorie with an inclusion of 94 gm of carbohydrates, 0.2 grams of protein, 0.5 grams of dietary fiber, 10 mg of calcium, 1.2 mg of iron and negligible amounts of fat, carotene, thiamine and ascorbic acid and fats. It does not offer any significant quantity of vitamins or minerals. As a starch, the health benefits of sago come primarily from carbohydrates. This carbohydrate content allows sago to function as a staple food in several regions of the world. Sago is also low in fat and has no protein. Since, the nutritional content of sago is quite low; people often mix sago with other ingredients that offer essential vitamins and nutrients, such as milk or fruits and vegetables. So, sago cultivation is often the most ecological appropriate form of land-use and the nutritional deficiency of the food can often be compensated for with other readily available foods (Lie, Goan-Hong, 1980) [10].

Material and Methods

The material used and methods adopted during the course of this investigation are given in this chapter under the appropriate heads

Experimental Materials

The following ingredient was used for the research work.

Toned Milk

All ready standardized fresh toned milk of 'Natural Milk' brand was procured from local market of Latur city.

Citric acid

Citric acid was procured from local market and used for the preparation of sago Paneer.

Sago powder

Good quality sago was purchased from the local market. It was cleaned and converted into fine powder by way of grinding. It was sieved and then mixed in hot standardized toned milk. The content was again heated for some time to get effective gelatinization and homogenous mixing of sago powder with milk.

Paneer blocks: Wooden block of size 7 x 6 x 4 inches was used for sago Paneer preparation.

Polythene bags

Polythene bags (200 gauge) was obtained from local market and used for packaging the sago Paneer.

Methodology

Preparation of sago Paneer

The toned milk was heated up to 82 °C for 5 min and then mixed the sago powder as per treatment level and cooled the milk at 70 °C and coagulated at this temperature in a steel vat with 2 liter capacity. After complete coagulation the stirring was stopped and the curd allowed settling down for 5 min. The whey was then drained through a stainless steel stainer. The curd was collected and filled in wooden blocks lined with strong and clean muslin cloth. The blocks used was a rectangular wooden blocks (7 x 6 x 4 inches) with holes on its side to facilitate the expulsion of whey. This frame was rested on a wooden blocks, filled with curd and mounted with another plank pressure was applied on the top of the hoop by placing a 35 kg/cm^2 for 15-20 min. The pressed block of curd was removed from the hoop, cut into pieces and immersed in chilled water for 2 to 3 hours. The chilled Paneer was then removed from water to drain out and stored for cooling to

room temperature (37 °C) and packed in polythene bag and finally storage in refrigerator (5 °C).

Preparation of sago Paneer

Following method/procedure was followed during experiment,

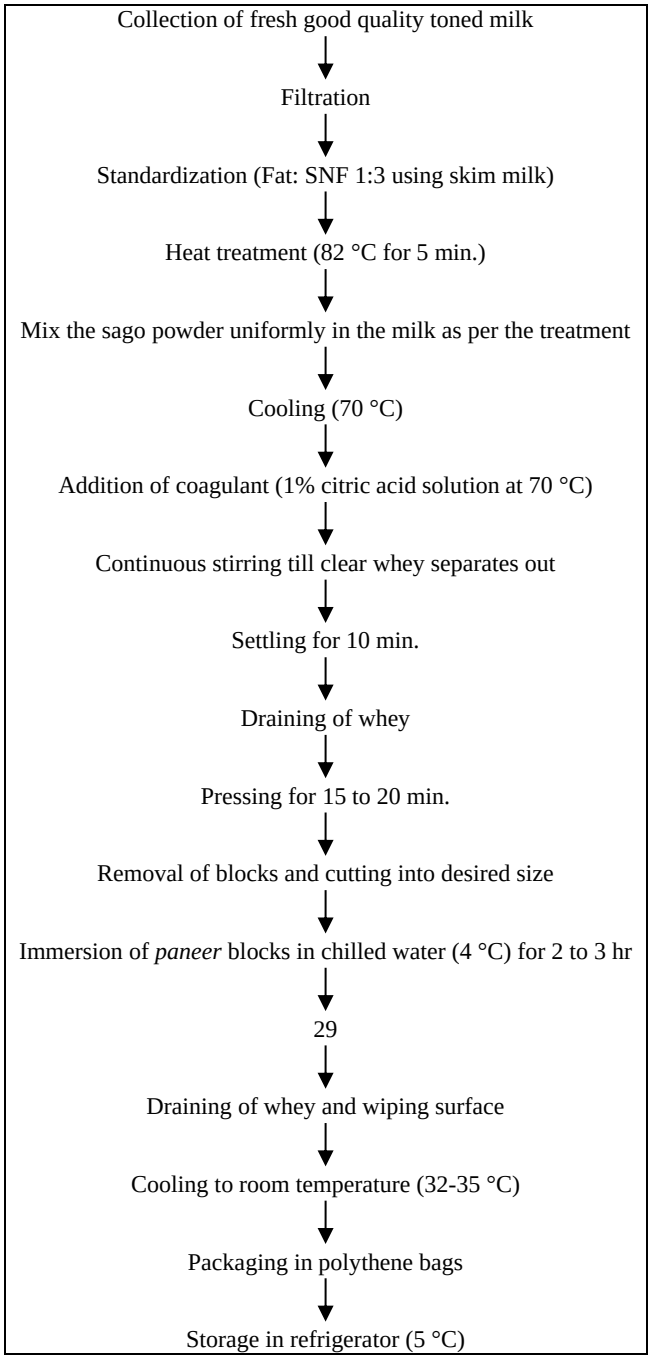

Fig 1: Flow diagram for manufacture of sago Paneer (Bhadekar, 2003) [3]

1. Optimization of stage of addition of sago powder to toned milk

- Adjustment of temperature for preparation of sago Paneer was selected at 37 °C, 72 °C and 87 °C.
- Sago powder was added in Paneer on the weight basis of milk.
- A trial was conducted to decide the stage of addition of sago powder.

1. At room temperature stage
2. At 72 °C temperature stage
3. At 87 °C temperature stage

2. Optimization of level of addition of sago powder to toned milk

For preparation of Paneer from toned milk using sago powder, the treatment combination was as per follows

T_1 - 100 Parts of toned milk
T_2 - 97.50 Parts of toned milk + 2.50 Parts of sago powder
T_3 - 95.00 Parts of toned milk + 5.00 Parts of sago powder
T_4 - 92.50 Parts of toned milk + 7.50 Parts of sago powder

The sago powder so obtained was added in toned milk at the time of heating process.

The different levels were tried and compared with control (T_1)

3. Storage life of sago Paneer

The sago Paneer samples were subjected to storage studies both at ambient (37 °C) and refrigeration temperatures (5 °C) along with the control sample to know the storage stability of sago Paneer. The samples stored at ambient temperature were analyzed every second day and the refrigerated stored samples at an interval of every second days for chemical, microbiological, rheological and sensory qualities. The sago Paneer samples were packed in plastic films. Score cards were provided to judges to evaluate the product by 9-Point Hedonic Scale.

4. Sensory quality

The freshly prepared samples of sago Paneer were subjected to sensory evaluation by a panel of judges. The samples were evaluated for its color and justifying appearance, body and texture, flavour and taste. Score cards were provided to judges to evaluate the product by 9-Point Hedonic Scale.

Sensory evaluation of sago Paneer

The freshly prepared samples of sago Paneer were subjected to sensory evaluation by a panel of judges. The samples were evaluated for its colour and appearance, body and texture, flavour and taste. Score cards were provided to judges to evaluate the product by 9- Point hedonic scale.

Results and Discussion

Preparation of sago Paneer

The toned milk was heated up to 82 °C for 5 min. and then mixed the sago powder as per treatment level and cooled the milk at 70 °C and coagulated at this temperature in a steel vat with 2 liter capacity. After complete coagulation the stirring was stopped and the curd allowed settling down for 5 min. The whey was then drained through a stainless steel stainer. The curd was collected and filled in wooden blocks lined with strong and clean muslin cloth. The blocks used was a rectangular wooden blocks (7 x 6 x 4 inches) with holes on its side to facilitate the expulsion of whey. This frame was rested on a wooden blocks, filled with curd and mounted with another plank pressure was applied on the top of the hoop by placing a 35 kg/cm^2 for 15-20 min. The pressed block of curd was removed from the hoop, cut into pieces and immersed in chilled water for 2 to 3 hours. The chilled sago Paneer was then removed from water to drain out and stored for cooling to room temperature (37 °C) and packed in polythene bag and finally storage in refrigerator (5 °C).

1. Optimization of stage of addition of sago powder

The sago powder was prepared as per procedure suggested by

Bhadekar (2003) [3].The sago powder was optimized by taking its proportion 2.5, 5.0 and 7.5 parts in combination of toned milk 97.50, 95.00 and 93.50 parts for the treatments T_2, T_3 and T_4 and treatment T_1 taken as a control from only toned milk as per treatment combination.

2. Standardization of technology for manufacture of sago Paneer

The temperature level was optimized by conducting sensory test for three levels of temperature i.e. at room temperature, at 72 °C and 87 °C on the basis of sensory test recorded for test/mouth feel only on 9 point hedonic scale by semi expert panel of judges. In all treatments, the maximum score for test/ mouth feel was recorded at 72 °C temperature level followed at room temperature and 87 °C temperature (Table 1).

The temperature was selected in the present study was akin with the result of Bhadekar (2003) [3] who develop an appropriate technique to utilize buffalo milk for preparation of Paneer using sago powder. Therefore, 72 °C was optimized for preparation of sago Paneer.

Table 1: Test/Mouth feel score of sago Paneer obtained from different temperature level

Treatment	37 °C	72 °C	87 °C
T_1	7.60	9.00	8.50
T_2	7.20	8.50	8.20
T_3	6.80	8.40	7.90
T_4	6.50	8.35	7.30

The values are the average of 4 replication.

Table 2: Treatment combination of toned milk and sago powder for Paneer preparation

Treatments	Parts of toned milk	Parts of sago powder
T_1	100	-
T_2	97.50	2.50
T_3	95.00	5.00
T_4	92.50	7.50

3. Yield or percent recovery of sago Paneer

The data on yield of sago **Paneer** is presented in Table 3. The results given in Table 3 showed that the average yield of sago Paneer prepared under different treatments were T_1 (18.59), T_2 (20.66), T_3 (21.57) and T_4 (22.18) percent respectively.

Table 3: Yield of sago Paneer from various treatment combinations

Treatments	Percent recovery (yield of sago Paneer)				
	R-I	R-II	R-III	R-IV	Mean
T_1	18.55	18.58	18.59	18.62	18.59^a
T_2	20.60	20.65	20.70	20.68	20.66^b
T_3	21.50	21.60	21.58	21.60	21.57^c
T_4	22.20	22.15	22.18	22.20	22.18^d
SE ± 0.019, CD at 5% 0.06					

The values with different small letters superscripts row wise differ significantly at 5% level of significance.

It is clear that the yield of sago Paneer increased from T_1 (18.59), T_2 (20.66), T_3 (21.57) and T_4 (22.18) percent due to increased level of sago powder. Sago powder contains starch 90-95 percent. Starch is hydrocolloids and hydrocolloids are hydrophilic in nature which resulted in binding of free water. Therefore, increase in the recovery percent age was noticed from T_2 to T_4. There were significant differences between successive treatments.

It is clearly indicated that addition of sago powder had definitely positive effect as far as the higher recovery is concerned.

Sachdeva and Singh (1988b) [20] studied the effect of adding starch to milk on quality, yield and total solids recovery of Paneer and reported the yield in the range of 20.1 to 22.6 percent.

Roy and Singh (1994) [12] studied on the effect of starch and sodium alginate on yield, moisture, total solid recovery of filled Paneer and stated that yield of the filled Paneer increased from 21.60 to 22.00 percent.

Panchabai (1994) studied the effect of hydrocolloids on yield of *chhana* from 16.10 to 20.30 percent, respectively.

Bhadekar (2003) [3] prepared Paneer from buffalo milk added with sago powder and recorded that the maximum recovery of 22.13 percent was recorded under T_3 followed by T_2 (21.25), T_1 (20.43) and T_0 (19.59) percent. The recovery of Paneer exhibited tendency to increase in yield with an increase in the incorporation of sago powder.

Conclusion

1. Optimization of stage of addition of sago powder in toned milk

The sago powder was optimized by taking its proportion 2.5, 5.0 and 7.5 percent in combination of toned milk 97.50, 95.00 and 92.50 percent for the treatments T_2, T_3 and T_4 and treatment T_1 taken as a control from only toned milk as per treatment combination.

In all treatments, the maximum score for test/ sweetness was recorded at 2.5 percent sago powder level followed at 5.0 percent and 7.5 percent sago powder level.

2. Optimization of temperature for addition of sago powder

The temperature level was optimized by conducting sensory test for three levels of temperature i.e. at room temperature, at 72 °C and 87 °C on the basis of sensory test recorded for test/sweetness only on 9 point hedonic scale by semi expert panel of judges.

In all treatments, the maximum score for test/ mouth feel was recorded at 72 °C temperature level followed at room temperature and 87 °C temperature.

3. Optimization of level of addition sago powder on sensory properties of Paneer

The acceptability of the sago Paneer was measured in terms of sensory attributes such as colour and appearance, flavour, body and texture, and mouth feel using 9 point hedonic scale by a panel of expert judges.

The sensory score for colour and appearance was notably better in case of being at T_1 i.e. (8.75) followed by T_2, T_3 and T_4 treatment combination 8.13, 7.00 and 6.13 respectively in sago powder. As far as the blends were concerned T_1 combination had been preferred by the judges for colour and appearance for control Paneer than the other treatment combinations.

Flavour scores of sago Paneer for the treatments T_1, T_2, T_3 and T_4 were 8.75, 7.88, 7.50 and 6.63, respectively. Treatment combination T_2 had been preferred by the judges for flavour than other treatment combination.

It was observed that the scores for body and texture were 8.75, 7.88, 6.88 and 6.25 for treatments T_1, T_2, T_3 and T_4 for sago Paneer respectively, The highest value of T_2 (8.25) blend of was preferred by the judges as far as body and texture than other treatment combination.

Mouth feel/ smoothness scores of sago Paneer for the treatments T_1, T_2, T_3 and T_4 were 8.75, 8.00, 7.25 and 6.25, respectively. T_2 treatment was found to be superior to other treatments. The overall acceptability of sago Paneer ranged in between 8.75 to 6.32 for sago Paneer. The lowest score was found in treatment T_4 (6.32) in sago Paneer and It was observed that the mean for overall acceptability of sago Paneer was 8.75, 7.97, 7.07 and 6.32 for treatments T_1, T_2, T_3 and T_4, respectively. The treatment T_2 was found to be superior in combination treatments of 2.5 parts in sago Paneer.

4. Yield or percent recovery in sago Paneer

The maximum recovery of 22.18 percent was recorded under T_4 followed by T_3 (21.57), T_2 (20.66) and T_1 (18.59) percent. The recovery of sago Paneer exhibited tendency to increase in yield with an increase in the incorporation of sago powder.

5. Effect of level of sago powder on sensory properties of Paneer

The acceptability of the sago Paneer was measured in terms of sensory attributes such as colour and appearance, flavour, body and texture, and mouth feel using 9 point hedonic scale by a panel of expert judges.

The sensory score for colour and appearance was notably better in case of being at T_1 i.e. (8.75) followed by T_2, T_3 and T_4 treatment combination 8.13, 7.00 and 6.13 respectively in sago powder. As far as the blends were concerned T_1 combination had been preferred by the judges for colour and appearance for control Paneer than the other treatment combinations.

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