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Ravula Sudharshan Reddy
Agricultural Processing and Food Engineering, College of Agricultural Engineering, ANGRAU, Bapatla, Andhra Pradesh, India

Gulshan Kumar Malik
Agricultural and Food Engineering Department, IIT Kharagpur, West Bengal, India

M Madhava
Agricultural Processing and Food Engineering, College of Agricultural Engineering, ANGRAU, Bapatla, Andhra Pradesh, India

Sheshasayana Golla
Agricultural Processing and Food Engineering, College of Agricultural Engineering, ANGRAU, Bapatla, Andhra Pradesh, India

Correspondence
Ravula Sudharshan Reddy
Agricultural Processing and Food Engineering, College of Agricultural Engineering, ANGRAU, Bapatla, Andhra Pradesh, India

Sensory evaluation of flavoured milk: Effect of incorporation of dried pineapple powder and drying temperature

Ravula Sudharshan Reddy, Gulshan Kumar Malik, M Madhava and Sheshasayana Golla

Abstract
The aim of the present investigation was to study the effect of incorporation of dried pineapple powder as an ingredient in milk. The pine apple slices were dried at different temperatures of 55, 60, 65, 70, 75 °C by keeping the air velocity constant of 1.5 m/s. The dried pineapples were made in to powder form and added in milk at different concentrations of 1, 1.5 and 2 g per 100 ml of milk. Moreover, the ascorbic acid content in dried pineapple was significantly decreased with increase in drying air temperatures. Sensory analysis of flavoured milk was revealed a clear profile for the mixing of powder and milk.

Keywords: Drying, powder, milk, flavoured milk, sensory analysis

1. Introduction
Pineapple (*Ananas comosus*) is one of the non citrus tropical and subtropical fruit, consumed all over the world because of its pleasant flavour and sweet-sour taste that refreshing sugar-acid balance (containing 15% sugar and malic and citric acid) and it is also rich in minerals (calcium, potassium etc) and vitamins (B1, B2, B6 and C) (Ravula *et al*., 2017a; Olanipekun *et al*. 2015; Bartolomé *et al*. 1995) [5, 4, 2] and it is low in fat and cholesterol. It is also a source of bromelin, a digestive enzyme. In addition to being eaten fresh, the fruit can also be canned and processed in different forms.
Pineapple is cultivated predominantly for its fruit that is consumed fresh or as canned fruit and juice. Drying is one of the oldest methods of food preservation practiced by humans and it extends the shelf life of the food product. Drying process makes the seasonal food available throughout the year to meet the thirst of food lovers (Arepally *et al*., 2017; Ravula *et al*., 2017b) [1, 6]. Pineapple powder converted to pineapple juice on Reconstitution. Also, used as a flavouring agent in ice cream, sweets, confectionery, bakery & biscuit products, baby foods, fruit chutney, snack food, food premixes for sweets, soft drink concentrates, milk based products, etc. Flavoured milk is the milk in which some flavour and colour have been added to make it more palatable. Flavoured milk contains milk fat percent equal to the minimum legal requirement prescribed for the milk from which it is prepared.
Nowadays, one can find a variety of flavoured milk in the market like chocolate flavoured milk, fruit flavoured milk and sterilized flavoured milk, which are more popular. The method of production of flavoured milk involves standardizing the milk to the desired fat and SNF percent (generally 2% fat and 9.5% SNF). Milk is pasteurized, cooled, bottled and kept under refrigeration. Popular flavours that are used in preparing different types of flavoured milk are strawberry, orange, lemon, pineapple, banana, vanilla etc. The pineapple is a seasonal fruit and the storage period of pineapple is 4 to 6 weeks only. Pineapple can be preserved long time by drying and powder form. The aim of the present investigation was to study the effect of incorporation of dried pineapple powder as an ingredient in milk at different concentration levels.

2. Materials and methods
2.1 Experimental set up
Pine apple (*Ananas comosus;* Simhachalam variety) used for the drying experiments were procured from a local market. Prior to drying, the pineapple pointed ends were trimmed, peeled off, sliced into 10 mm thick.

The drying experiments were performed in the hot air batch dryer which consisting of an air blower, heating section, temperature controller (40-120 °C) and drying chamber. Prior to start the experiment, the dryer was preheated for approximately one hour to ensure equilibrium conditions with set temperatures and air velocity for each run. The sliced pine apple (100 g) samples were uniformly spread onto the cleaned perforated trays and kept in the dryer for drying at different air temperatures of 55, 60, 65, 70 and 75 °C with constant air velocity of 1.5 m/s. During the drying process, moisture loss was recorded by a digital balance of ±0.001 g accuracy (Testing Instrument Pvt. Ltd., India) till a constant weight was achieved. Drying was stopped when the moisture content reached to 6-7% (w.b.) from an initial value of 85.85±1.19% (w.b.). The dried product was kept in polythene covers for the preparation of flavoured milk.

2.2 Determination of Ascorbic acid

The Vitamin C content in dried pineapple was determined according to the procedure explained by Ravula *et al*., 2017 [1] and Sadasivam and Manickam, 1992 [7].

2.3 Preparation of flavoured milk and its sensory evaluation

Locally available pasteurized toned milk (Fat 3.5%, SNF 9.5%) was taken for the preparation of flavour milk. The milk was heated up to boiling temperature in stainless steel vessel. The sugar about 4g was added to the heated milk and dissolved it completely. The milk was cooled to a temperature below 20 °C. The cooling was done in refrigerator. The pineapple powder was added to the milk with different concentrations of 1 g, 1.5 g and 2 g of powder per 100ml of milk. The flavoured milk was packed in to glass bottles and sealed with lid. The flavoured milk was stored in the refrigerator to determine the shelf life of the pineapple flavoured milk.

Sensory evaluation of any developed product is important for quality control and is often an issue in international trading. Most countries define quality and grades on sensory properties. In the present study, the flavoured milk can be characterized by four attributes: colour and appearance, flavour, taste and overall acceptability. The freshly prepared samples of flavoured milk samples were subjected to sensory evaluation by a panel of judges. A panel of judges drawn from the University community assessed the sensory quality of flavoured milk. A nine-point hedonic scale was used to point out the differences amongst samples. An average score of ten judgments was determined for each sample. Nine points were awarded as: like extremely-9, like very much-8, like moderately-7, like slightly-6, neither like nor dislike-5, dislike slightly-4, dislike moderately-3, dislike very much-2 and dislike extremely-1.

3. Results and discussion

The drying process was performed from initial moisture content (85.85±1.19 w.b.) of pine apple slices to final moisture contents of less than 7 kg water.kg dry matter^{-1} in convective dryer with different air temperatures of 55, 60, 65, 70 and 75 °C. All these drying temperatures had a significant effect on drying kinetics of pineapple slices. It is clearly observed from the Fig. 1, moisture content reduced expontially as the drying time increased at all drying air temperatures when the air velocity was kept constant. This continuously decrease in moisture content indicates that diffusion had governed the internal mass transfer. Moreover, increasing the drying air temperature reduced the drying time.

3.1 Ascorbic acid

The effect of drying air temperature on the ascorbic acid is depicted in Fig. 3. It was observed that increasing drying air temperature increases degradation of vitamin C in the dried sample. The ascorbic acid was more at the temperature of 55 °C whereas less at 75 °C. These results are good consistent with previous reports by Santos and Silva (2009) [8] for pineapple and kaya *et al*. (2010) [3] for kiwi fruit. Moreover, it is observed from the results, the temperature effect on vitamin C was more important than the time effect on the ascorbic acid degradation during drying process.

3.2 Effect of pineapple drying on flavoured milk and Sensory Evaluation

The sensory score for pineapple flavoured milk was carried out on the basis of attributes of colour and appearance, flavour, taste and overall acceptability.

3.2.1 Colour and appearance

Based on the data obtained from sensory evaluation by a panel of 10 members, colour and appearance of pineapple flavour milk was found to be as 8.5, 8.2, 8.1, 7.9, and 7.3 on hedonic rating scale at the temperatures of 55, 60, 65, 70, and 75ºC, respectively. It was observed that the variation of colour at different temperatures is shown in Fig. 3. The better colour was found by panel at the temperature of 55ºC. As increasing the temperature of drying results in faster in drying rate. Therefore, the colour of the dried pineapple slices was turned into darker.

3.2.2 Flavour

The flavour of pineapple flavour milk was found to be as 8.1, 8, 8.3, 7.5and 7.3 on hedonic rating scale at the temperatures of 55, 60, 65, 70, and 75 °C, respectively. It was observed from the results that the flavour of pineapple flavoured milk was good. But, better flavour was observed by sensory panellists at temperature of 65 °C compared to other temperatures. Moreover, when thin pineapple slices were exposed to high temperatures i.e. 70 and 75 °C, it may cause browning or burnt flavour, protein denaturation. Therefore, the flavoured milk was in burnt flavour.

3.2.3 Taste

Taste is determined mainly by organic acid–sugar content balance. Taste of pineapple flavour milk was found to be as 8, 8.3, 8.5, 8 and 7.6 on hedonic rating scale at the temperatures of 55, 60, 65, 70, and 75 °C, respectively. Fig. 3 represents the effect of different concentration levels of dried pineapple powder on taste at different temperatures. The better taste was observed at temperature of 65 °C. The flavoured milk had unpleasant taste at the temperature of 75 °C may be due to burnt flavour. In general, the fresh pineapple juices contains considerable amount of acids which results in sometimes in sour taste. But the judges observed that the taste of flavour milk was not in sour taste.

3.2.4 Overall acceptance

Fig. 3 shows the effect of different concentration levels of dried pineapple powder on overall acceptability at different temperatures. It was observed that the overall acceptances of pineapple flavour milk by judges as maximum at temperatures of 65 °C where as minimum at temperature of 75 °C.

4. Storage period

Storage period of pineapple flavoured milk was maximum at concentration of 1gram powder per 100 ml of milk. The storage period was less at concentration of 2 gram powder per 100 ml. The reason behind this may be due to chemical reactions occurs faster at higher concentration that results in spoilage of flavoured milk.

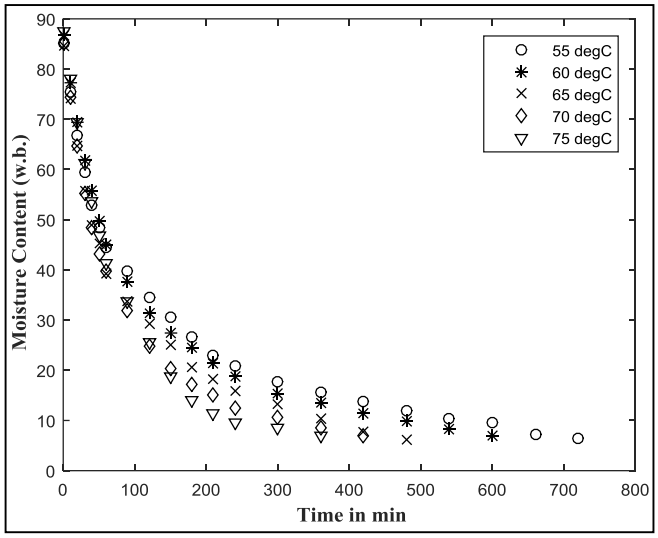

Fig 1: Plot of moisture content versus drying time at various drying air temperatures

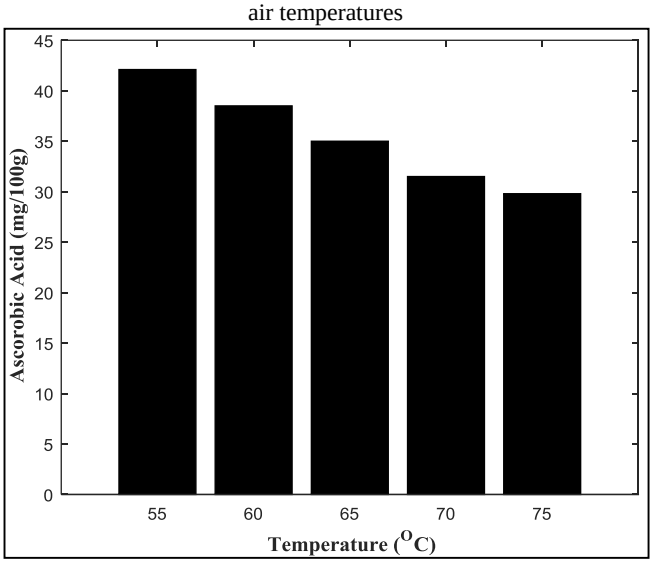

Fig 2: Effect of drying air temperature on ascorbic acid content in dried pineapple powder

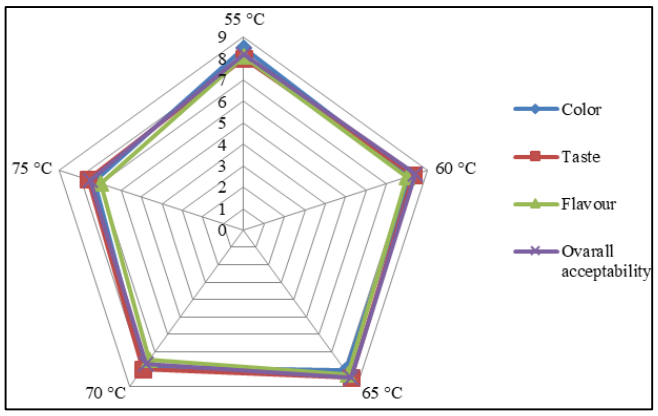

Fig 3: Sensory evaluation of pineapple flavoured milk

5. Conclusions

Pineapple powder can be used as a flavouring agent in ice cream, sweets, confectionery, bakery & biscuit products, baby foods, fruit chutney, snack food, food premixes for sweets, soft drink concentrates, milk based products, etc. In the present investigation, the fresh pineapples were taken, cleaned and cut into desirable size. The tray drier was used for drying the pineapple slices. The dried pineapple slices was then made in to powder form, and mixed with pasteurized toned milk at different concentrations to prepare the pineapple flavoured milk. It was observed that decrease in the ascorbic acid content with an increase in drying air temperature. Sensory quality of pineapple flavoured milk was good at the temperature of 65 °C. Storage period of pineapple flavoured milk was maximum at concentration of 1g powder per 100ml of milk. It was found that sensory quality of pineapple flavoured milk was good at the concentration of 2 g of sample per 100 ml of milk.

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