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Optimisation of citrus fruits extracts in the formulation of paneer

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Abstract
Paneer is a rich source of animal protein for vegetarians available at a comparatively lower cost. It is obtained from cow's or buffalo's milk by precipitation with sour milk, lactic acid or citric acid. The present study was done to explore with the objective of utilizing citrus fruits extracts in the formulation of paneer. It was aimed at optimizing the quantity of citrus fruits extracts namely lemon, sweet lime, orange and citron to develop good quality paneer and to find the effect of acid content in the precipitation process. The pH of the different fruit extracts was determined to be 2.7 (lemon), 4.3 (sweet lime), 3.2 (orange), 2.5 (citron). The type of milk, quantity of milk and the temperature were kept constant for the formation of paneer. The findings for the quantity of extract (ml) for precipitating the milk revealed that, citron and lemon extracts were required in the least quantity (7.5 ml) for precipitation when compared to other extracts. The time taken for precipitation was least for citron extract (35 seconds). The moisture and ash content for all paneer samples were similar to each other respectively. The utilization of citrus fruit extracts significantly changed the peroxide value of paneer. The physical features of these developed paneer samples retained it's sensory qualities for a period of one week when stored at refrigeration temperature. The overall acceptability scores showed that citron based paneer sample was superior in all sensory parameter.

Keywords: paneer, citrus fruit extracts, precipitation, peroxide value

1. Introduction
The origin of paneer is popular in South Asian part of the world especially North India. The paneer prepared is generally softer and creamier in texture. Paneer is a rich source of animal protein for vegetarians available at a comparatively lower cost. Paneer is commonly obtained from cow's or buffalo's milk by precipitation with sour milk, lactic acid or citric acid. It is estimated that 1% of the country's total milk production is converted into paneer and the annual production estimates at 150, 000 tonnes (Singh and Immanuel 2014) [2].
The formation of paneer requires acid for precipitation. Citrus fruits are natural source of acid content which doesn't have any ill effects. The fruits extracts has been used as the source of acid content for formation of paneer. Citrus fruits have a higher acid content than other fruits and hence can be effectively used for the precipitation process.
The citrus fruits used for the formulation of paneer are lemon, sweet lime, orange, citron. These four fruits contain different quantity of juice extracts. In citron fruit, the quantity of extract is less when compared to other three citrus fruits as albedo part of the fruit is thicker. The pH of the different fruit extracts was determined to be 2.7 (lemon), 4.3 (sweet lime), 3.2 (orange), 2.5 (citron). In this study, extracts from citrus fruits have been used for the precipitation of milk. The paneer formulated from the citrus fruits extracts does not contain any food additive and it is safe for consumption.

2. Materials and methods
2.1 Raw materials
Lemon, sweet lime, orange and citron and full fat milk were procured from the local market, Chennai, India.

2.2 Experimental procedure
2.2.1 Determination of pH for citrus fruits extracts
The pH of the citrus fruits extracts was determined using the pH meter. The pH meter was first calibrated with water and the pH of the samples were determined. The litmus papers were also used to determine the pH of the extracts.

2.2.2 Preparation of paneer with citrus fruits extracts
Paneer was prepared by boiling the milk at 100^0C. The juice was extracted from different citrus fruits like lemon, sweet lime, orange and citron. Using these extracts the milk was coagulated and four different varieties of paneer were formulated.

2.2.3 Determination of moisture and ash content of paneer (AOAC, 2000) [1]
Moisture content
Moisture was analysed in samples by oven drying method using the formula:

$$\% \text{ Moisture} = \frac{(\text{wt of wet sample - wt of dry sample})}{\text{wt of wet sample}} \text{ x } 100$$

% Moisture = (wt of wet sample - wt of dry sample) x 100
wt of wet sample

Ash content
Ash content was determined by dry ashing method % of ash content in the given sample = Wt of Ash / Wt of sample X 100

2.2.4 Determination of peroxide value for paneer
5g of the sample was accurately weighed in to each of two

250 ml glass stoppered Erlenmeyer flask. 30 ml acetic acid –chloroform solution was added and swirled to dissolve. 0.5 ml saturated KI solution was added and allowed to stand with occasional shaking for 1 min. 30 ml distilled water was added and samples slowly titrated with 0.1 N sodium thiosulfate solution with vigorous shaking until yellow colour is almost gone. 0.5 ml 1% starch solution was added titration continued, shaking vigorously to release all iodine from chloroform layer, until blue colour just disappeared.

$$\text{Peroxide value (meq peroxide/ kg fat)} = \frac{(S\text{-}B) \times N \quad *100}{W}$$

2.3 Sensory analysis
Samples were analysed for its sensory characteristics like colour, appearance, taste and texture using 5-point hedonic scale (5- like extremely to 1- dislike extremely)

3. Results and Discussion
3.1 pH for citrus fruits extracts
The results of pH values among the citrus fruits showed that citron had the lowest pH followed by lemon and orange, whereas sweet lime scored a pH of 4.5.

Table 1: pH level of citrus fruits

Fruits	pH
Lemon	2.7
Sweet lime	4.3
Orange	3.2
Citron	2.5

3.2 Paneer yield
The paneer was formulated using a standard quantity of milk (250 ml) and boiled at temperature of 100^0C. The quantity of citrus juice and the time taken for the precipitation of milk varied. This was due to the variation in acid content of the citrus fruits. The paneer yield using orange juice extract has the maximum yield (61.6g) followed by citron (59.87g) and lemon (58.47g) and sweet lime with the minimum yield (39.04g).

Table 2: Yield of paneer variant

Fruits	Quantity of Milk (Ml)	Temperature (^{0}C)	Quantity of juice (ml)	time (min)	Weight of Paneer(g)
Lemon	250	100	7.5	5	58.47
Sweet lime	250	100	60	10	39.04
Orange	250	100	37.5	7	61.6
Citron	250	100	7.5	35 seconds	59.87

3.3 Moisture and ash content
The moisture and ash content of the variations had similar values. This proves that there is no significant difference in the moisture and ash content among the variations. The values are as follows:

Table 3: Moisture and ash content of each paneer

Fruits	Moisture Content (g)	ASH Content (g)
Lemon	3.790	0.129
Sweet lime	4.116	0.161
Orange	3.774	0.132
Citron	4.396	0.131

3.4 Peroxide value of paneer
The peroxide value indicates the quality and the shelf life of paneer. The Peroxide value were determined 24 hours after the preparation of the paneer. The peroxide values were similar among all the variations. A similar study was conducted using fruit peels which showed similar peroxide values (0.09) after 24 hours of paneer precipitation (Singh and Immanuel 2014) [2].

Table 4: Peroxide values of paneer

Fruits	Peroxide Value(meq)
Lemon	0.114
Sweet lime	0.214
Orange	0.114
Citron	0.104

3.5 Sensory analysis
The sensory analysis was done by analysing the parameters like colour, appearance, texture and taste. Based on these criteria the overall acceptability was calculated by taking the mean values. The overall acceptability showed that citron and lemon precipitated paneer were acceptable than orange and sweet lime precipitated paneer.

Table 5: Sensory analysis of paneer variant

Sample	Colour	Appearance	Texture	Taste	Average
Lemon	5	5	4	3	4.25
Sweet lime	4	3	3.5	4	3.6
Orange	3	4	4	4.5	3.8
Citron	4	5	4	4	4.25

4. Conclusion
India is one of the largest producers for milk and milk products, accounting for 18.5% in world's production. The citrus juices were extracted from lemon, sweet lime, orange and citron. Highest acid content was found in citron followed by lemon, orange and least in sweet lime. The findings for the quantity of extract (ml) for precipitating the milk revealed that, citron and lemon extracts were required in the least quantity (7.5 ml) for precipitation when compared to other extracts. The time taken for precipitation was least for citron extract (35 seconds). The moisture and ash content for all paneer samples were similar to each other respectively. In this study it is found that, paneer formulated

from the citron fruit extract had good yield (59.87), better peroxide value (after 24 hours - 0.104) and highest overall acceptability (4.25) when compared to paneer formulated using other citrus fruits extracts. A further study can be conducted for a scale up using citron fruit extract. Thus, it is concluded that citron fruit extracts have better ability in milk precipitated products and has good sensory qualities.

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