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Role of ginger in curdling of milk and subsequent development of ginger curd using different flavouring agents

Dr. Adrija Sarkar[1], Shagufta Alam[2]
[1] HOD & Assistant professor, Department of Food Science and Nutrition Management, Lower Rawdon Street, Kolkata, West Bengal, India
[2] Post Graduate student, Department of Food Science and Nutrition Management, Lower Rawdon Street, Kolkata, India

Abstract
Ginger is a multifaceted spice. Its most common use known to man is that its used in almost all household as a basic cooking ingredient. Apart from its use in food to provide flavour, having medicinal properties against conditions like nausea, dizziness, menstrual pain, arthritis, etc., it also has milk curdling property. When added to warm milk it instantly curdles it thus forming a curd quiet similar to that available in the local dairy shop or supermarkets, but with a gingery aftertaste to it. The study was conducted starting with the process of extracting fresh ginger juice and then using it to curdle the milk. The purpose of this study was to observe and form curd using ginger extract and in doing so enhance its taste with the addition of different flavouring agents. This study helped us understand the component present in ginger that causes the milk to curdle. Flavour enhancement was done so as to make it more palatable to the Indian taste bud. The final product was chosen based on the 9- Point Hedonic Scale.

Keywords: ginger, milk, curdle

1. Introduction
Zingiber officinale roscoe or ginger as it is more commonly known is a flowering plant in the family Zingiberaceae whose rhizome, ginger root or simply ginger, is widely used as a spice or a medicine. Ginger is an herb. It can be used fresh, dried and powdered, or juiced or as oil.
Ginger is commonly used to treat various types of "stomach problems," including motion sickness, morning sickness, colic, upset stomach, gas, diarrhoea, nausea caused by cancer treatment, nausea and vomiting after surgery, as well as loss of appetite.
Studies conducted on ginger demonstrate its proteolyitc activity, and thus it's highly used as one of the most common protease when it comes to tenderizing meat as it acts more on the collagen than on actomyosin and the combined activity causes the meat to become tender (Kim *et al*., 2007) [1].
The method of preparation is as simple as extracting the ginger juice by blending the cut pieces of ginger and passing it through a sieve to get the juice. This extract is then added to milk which has been boiled with or without the addition of sugar. After adding spoonful of the extract, the mixture is allowed to stand for a few minutes after which it solidifies to for a soft curd which can be eaten right away.
The main reaction behind the formation of ginger curd is that the Ginger contains the protease zingipain. When milk is added to ginger juice, this protease catalyses denaturation of the protein in the milk, changing it from a water-soluble form to a water-insoluble form, and leads to the formation of milk curd.
In the studies that have been conducted so far the Ginger Protease has been extracted through chemical processes and then studied for its proteolytic activity. In this study the unprocessed juice of fresh ginger rhizomes was extracted manually and used immediately to coagulate the milk. The immediate use of the extract was necessary as studies have shown that the activity of the protease varies when its extracted using chemical methods and thus stabilizers are used to maintain its quality and activity (Adulyatham and Owusu-Apenten, 2005) [2]. The fresh ginger juice was added to milk which had been boiled. The temperature of the milk was reduced to about 60℃ as studies have shown that the proteolytic activity is highest at the said temperature (Thompson *et al*., 1973) [3]. As the temperature increases the activity of the Ginger Protease decreases. The milk along with the ginger juice was left undisturbed for the milk to curdle. For the variations of flavour, cardamom powder was added to it in different quantities.

2. Materials and Method
a. Material: Fresh Ginger rhizomes were bought from the local market. Care was taken when buying as the freshest of the rhizomes were chosen. Homogenized, pasteurized packet packed milk from the supermarket was procured. The packaged milk was stored at freezing temperatures before the packet was cut opened to be used for the study. Widely available food grade thermometer was used to measure the temperature of the milk when it was left to cool.
b. Selection of Panel Members: The evaluation of the product was done by 20 panel members between the age group of 21 years to 25 years. All recipes were evaluated by the same panel members.
c. Method: Fresh ginger rhizomes were taken, peel and

chopped. They were then crushed to a pulp using standard mortar pestle. The pulp was then taken into a sieve and the juice was extracted from it and kept aside. In the meanwhile, milk was boiled and allowed to cool to a temperature of 60℃. when the temperature was as required, the milk was poured into the bowl containing the fresh ginger juice and it was allowed to curdle. The curdled mass was stored overnight at refrigerated temperature before it was given to a group of panellists for Sensory Evaluation, the scores of which were given according to the 9-Point Hedonic scale.

Table 1: Variations of Ginger Curd

Variation	Basic Recipe	Variation I	Variation II	Variation III	Variation IV	Variation V	Variation VI
Milk (ml)	125	125	125	125	125	125	125
Ginger Juice (ml)	3.75	3.75	3.75	3.75	3.75	3.75	3.75
Sugar(gm)	-	5	10	15	-	-	-
Sugar Replacer (gm)	-	-	-	-	15	15	-
Honey (gm)	-	-	-	-	-	-	15
Cardamom (gm)	-	-	-	-	2.5	5	2.5

Different variations of sugar were added to understand the flavour of the curd so formed. The sugar was replaced with sugar replacers to keep the nutritional content of the end product same as that of the Basic Recipe. Different variations of cardamom powder were also added to the product to maximize the flavour and have a positive effect on the final product.

After the variations were made and assessed by the panel members, the final product was chosen based on the highest score given to a particular variation.

3. Results & Discussion

a. Sensory Evaluation: Attributes to be scored were colour, appearance, flavour, texture and taste. Each curd sample was placed on a bowl with the corresponding code. A sensory evaluation sheet was also kept. The panel members were briefed with the process of evaluation. They were strictly asked not to discuss or communicate during the process of evaluation. Acceptability of the recipes was evaluated from the ratings obtained through the score card using 9-Point Hedonic Scale during the sensory evaluation. The sample with the maximum score in each recipe was identified as the most acceptable variation.

In this graphical representation of the scores given to each variation for measuring the Overall score and the "like-ability" can be seen in Variation IV whereas the lowest score has been given to the Basic Recipe.

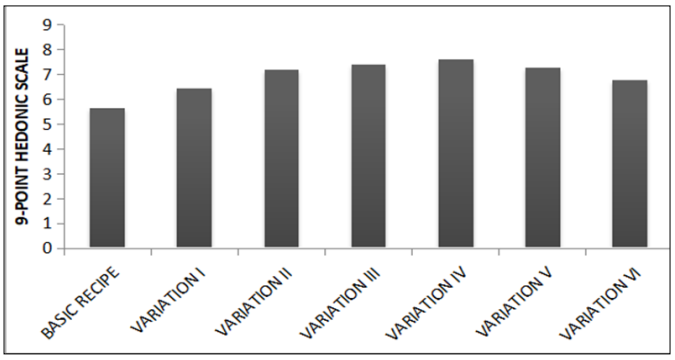

Fig 1: Overall Score of Ginger Curd

The development of the curd using Ginger Protease had taken place in stages. The recipe was adjusted in accordance to attain the final product. The reason of the progression of the chart has been discussed below:

Basic recipe: This was the first formulation where just fresh ginger juice was added to boiled milk. No sugar was added and the product was completely bald with a "gingery" after taste.

Variation I: In this variation, just 5 grams of sugar was added. This amount was not enough to bring considerable amount of sweetness to the curd.

Variation II: Subsequently the amount of sugar was increased a further of 5 grams to a total of 10 grams. But the addition of 10 grams of sugar was also not sufficient to bring about the desired sweetness.

Variation III: In this variation 15 grams of sugar was added to the curd thus getting a positive response among the panellists. This amount of sugar was just about right and most desired by the panellists.

Variation IV: Once established that 15 grams of sugar was sufficient to bring desired sweetness to the product, it was replaced with a generic brand of sugar replacer so that the nutritional content does not increases and so remain same as that of the basic recipe. In terms of flavouring agents, Cardamom powder was added at a quantity of 2.5 grams. This variation was highly acceptable among the panellists scoring a value of 7.6 out of 9 on the 9-Point Hedonic Scale.

Variation V: In this variation the amount of cardamom powder was increased to 5 grams. This was not well accepted by the panel members. It was reported that the amount of cardamom powder added was beyond necessary and gave a bitter after taste.

Variation VI: This variation was made just with the replacement of sugar replacers with honey. It wasn't welcomed by the panel members as it did was not a good flavour combination and the curd formation was not as seen in the other variations. This may be due to the fact that honey was added to the product which might have led to the curd formation not take place as what was expected.

Apart for the Overall Score, some other attributes that were also taken into consideration have been discussed below:

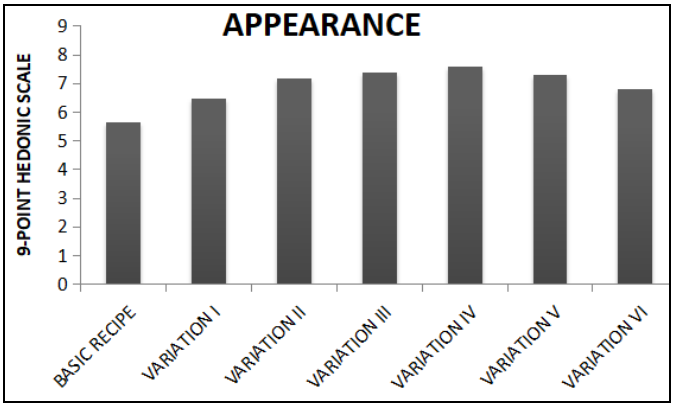

Fig 2: Graph depicting the scores of Appearance

In this graph it can be seen that the lowest appearance score was given to basic recipe, with the score being 6.733 out of 9-point hedonic scale. This can be because of the fact that the curd did not have a firm appearance as compared to variation IV, which was more firmly set and had the addition of sugar replacer and cardamom in it.

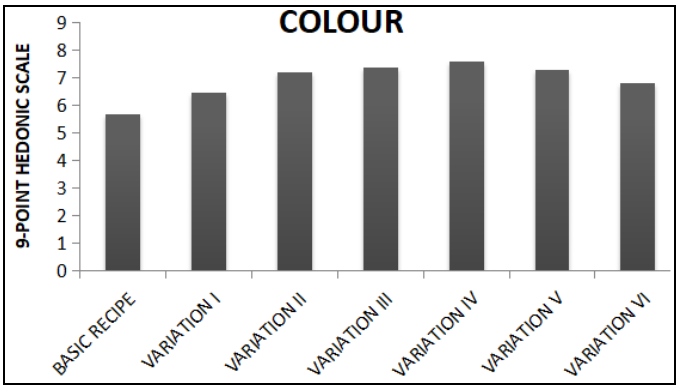

Fig 3: graph depicting the scores of Colour

In this graph it can be seen that the lowest score for colour has been scored by variation I, which is 6.933 out of 9-point hedonic scale. The colour of this curd was white while the highest score has been given to variation VI, which is 8.2 out of 9-point hedonic scale. This can be because; variation VI had a brown caramel colour to it because of addition of honey to it which contributed to the colour.

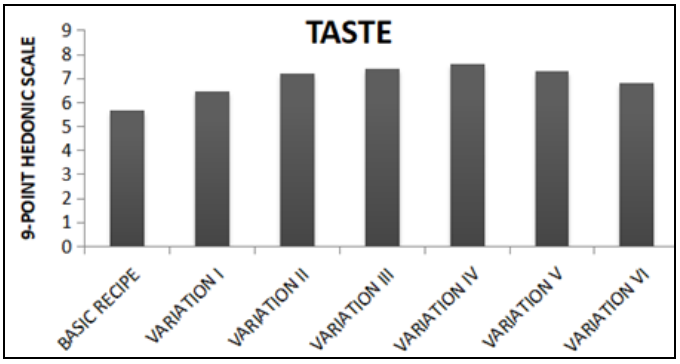

Fig 4: Graph depicting the score of Taste

In this it can be seen that the highest score given for taste was to variation III, which was 7.266. This maybe because 15 grams of sugar was added which complimented the taste of ginger. The lowest score on the other hand was given to basic recipe with the score being 4.733 out of 9-point hedonic scale. This is because the ginger had an overpowering and bitter aftertaste to it, which was not desirable at all.

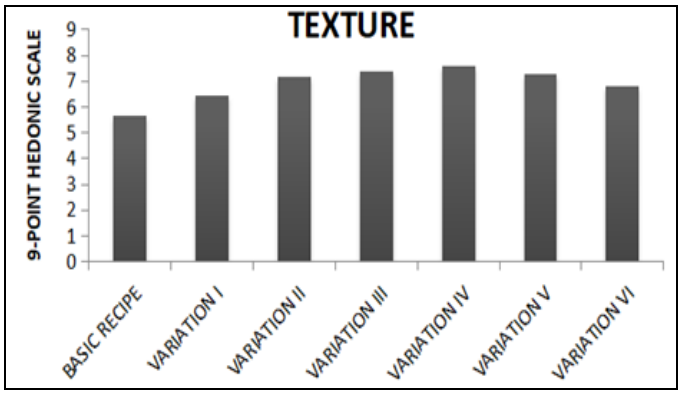

Fig 5: Graph depicting the score of Texture

In this graph it can be seen that the lowest score for texture has been scored by variation VI, which is 5.8 out of 9-point hedonic scale. This is because the curd did not set due to the addition of honey and cardamom powder. Variation V also did not set firmly like curd even though sugar replacers were added to it. This can be due to the addition of cardamom powder which did not allow the curd to set firmly. When refined sugar was added to variations I, II and III, it was noted that the curd did not set as firmly as it did without the addition of sugar in the basic recipe. This was because the dissolving sugar increased the water content of the milk, thereby rendering the curd to not set properly.

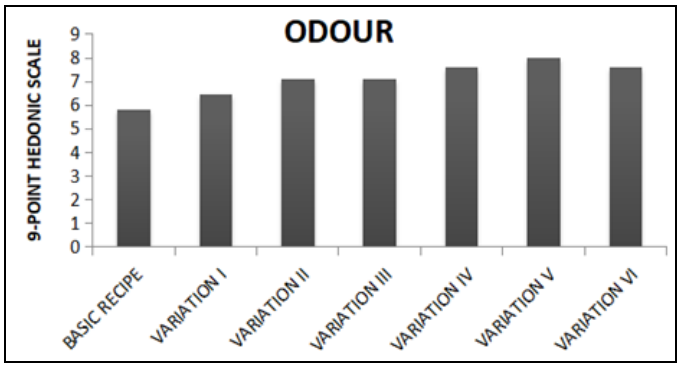

Fig 6: Graph depicting the score of Odour

In the graph it can be seen that the highest score for odour parameter was scored by variation V which is8.0 out of 9-point hedonic scale. This was because this variation had 5 grams of cardamom powder added to it which gave a fragrant smell to it. The lowest score on the other hand was given to the basic recipe, which was 5.8 out of 9-point hedonic scale. This was because in the basic recipe nothing was added apart from ginger extract.

4. Conclusion

This study was conducted to see the effectiveness of the

Ginger Protease that can be extracted for fresh Ginger Juice. Instead of extracting the Ginger Protease through a series of chemical reactions and using stabilizers we decided to extract the fresh juice and use it instead to curdle milk and study its effectiveness. From this study we understood the action of ginger protease and what it does when added to milk. This study helped us understand and realize the prospects of commercial use of Ginger Protease- used as a vegetable source of rennet and also used as meat tenderizer. Ginger is widely available throughout India and is a very popular spice. Through the easy availability of the rhizome and the knowledge that has been gathered from this study, it can be said that ginger is more than a spice and a meat tenderizer. It has huge prospects to be used as a vegetarian source of rennet and thus can be used to make curd and its different products with the added health benefits.

5. Acknowledgement

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6. Reference

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