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Flour pretreatment on the quality characteristics and oil absorption of traditional South Indian festive snack

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This study aims to determine the impact of pretreatment of rice flour on the quality characteristics and oil absorption of the deep fried South Indian festive snack item namely, "Seedai". Products were prepared using untreated rice flour (control) and dry heat treated rice flour. The experimental product had higher sensory scores over the control product. Fat absorbed by the control was 29%, but pretreating the rice flour (dry heat treated) decreased it to 22%. Similar results were seen in case of "oiling off" values. Free Fatty Acid, water, and crude fat were lower in the experimental product when compared to that of the control product. Therefore, the study revealed that dry heat as a method of pretreatment for rice flour was found to improve the quality of Seedai, a traditional South Indian festive snack.

Keywords: Pretreatment, Rice Flour, Roasting, Festive Snack, *Seedai*

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India is a land of rich tradition and culture. It is one of the few countries in the world in which people of different religions live together. Religious festivals are commonly celebrated in recurring cycles every year. During festivals special dishes are prepared and placed as an offering to God. Festive snack foods are mostly deep fried. *Seedai* is one among the South Indian traditional festive snack, deep fried and made of rice flour.

Frying is a domestic cooking process that contributes unique sensory properties and palatability of the product which are highly accepted by the consumers of all age groups. Deep fat frying is a practice of immersing foodstuff in hot oil creating contacts between oil, air and the food at the elevated temperature[1]. The simultaneous heat transfer of oil, food, and air during deep fat frying produces the desirable quality of the fried food[2]. Deep frying helps to reduce the moisture content of the food and thereby increases the shelf life of the product combined with imparting characteristic colour, texture, and flavour to the product. Fried foods absorb considerable amount of oil during frying (about 40 %) and the quality of fried food depends on the quality of the oil that is absorbed[3]. However, now-a-days people are health conscious, with respect to their fat and calorie intake. As *Seedai* is a deep fried product, its consumption though generally limited during festive seasons become questionable in view of health concerns. Therefore, roasting as flour pretreatment to decrease oil absorption was investigated in this study.

Roasting is a simple, domestic pretreatment that has a significant impact on the overall quality and shelf life of the final fried products[4]. It is one among the pretreatment done in flours to increase the shelf life and acceptability of the products. Roasting improves flavour, texture, and nutritive value of grains[5]. An added advantage of roasting is that the flour can be stored in air tight containers for longer time than the untreated rice flour.

Therefore, this study was undertaken to determine the impact of flour pretreatments on the quality characteristics and oil absorption of *Seedai*. The sensory parameters of the control and experimental samples were evaluated. The products were tested for crude fat, moisture and Free Fatty Acid (FFA) content.

Methodology

Rice (*Oryza sativa* L.) and other ingredients like butter, black gram dhal (*Vigna mungo*), and refined sunflower oil were procured from the local market.

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Preparation of *Seedai*

The ingredients were mixed together and made into dough by adding water. Small marble-sized balls were made from the dough which was then deep fried in a measured quantity of oil (Fig. 1).

Sample preparation

The control flour *Seedai* (CFS) and the experimental roasted flour *Seedai* (RFS) were prepared by deep frying the rice balls prepared. Fifty gram of the end product was powdered and used for chemical analysis. The product was stored in polyethylene pouches for one week and then tested for Free Fatty Acid content (Fig. 2).

Physical and chemical analysis of the product

Moisture content

The moisture content of the flour and the product was determined using oven drying method, by weighing 5 gm of each sample in a pre-weighed, dry, and clean Petri plate. The samples were then placed in a hot air oven, maintained at 110°C. After 16 to 18 hrs, the plates were transferred into a desiccator to cool and then the final weight was taken. The drying process continues till a constant weight was obtained.

$$\text{Moisture content (\%)} = \frac{\text{Weight of sample} - \left(\begin{array}{l}\text{Final weight of dried sample} - \\ \text{Weight of moisture plate}\end{array}\right) \text{x } 100}{\text{Weight of sample}}$$

Oil absorption

A measured quantity of oil was taken and 100 gm of rice balls were dropped inside the oil and fried. The amount of oil absorbed by 100 gm of the product (*seedai*) was calculated by the difference in weight of oil before and after frying the product.

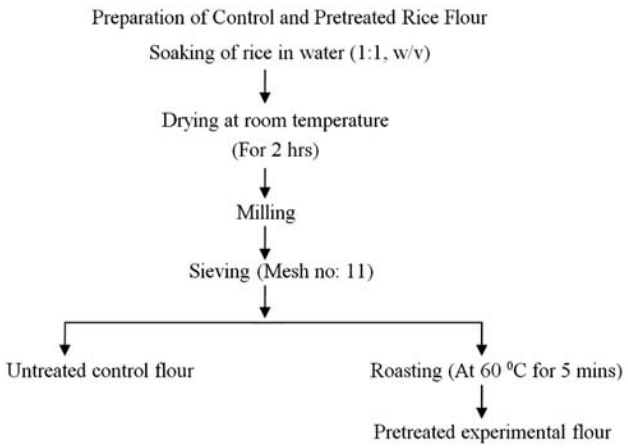

Fig. 1- Preparation of *Seedai*

Oiling off

A filter paper was weighed and a pre-weighed *seedai* was placed on the filter paper. The sample was removed an hour later and the filter paper was weighed again to get the final weight. The difference in the weight of the filter paper gives the value for oiling off.

Oiling off (gm) = Final weight of the filter paper – Initial weight of the filter paper[6]

Crude fat content

The crude fat content of the sample was determined by the Soxhlet method[7]. Ten gm of sample was weighed and packed in Whattman's filter paper and placed in a pre-dried thimble. A pre-dried soxhlet flask was weighed (W_1) and was filled with hexane to half of the flask. The soxhlet flask, and condenser were assembled. The fat from the sample was extracted in the soxhlet extractor for 3 hrs. The boiling flask was cooled in a desiccator and weighed (W_2).

$$\text{Crude fat } (\%) = \frac{(W_2 - W_1)\text{ X } 100}{\text{Weight of the sample } (\text{gm})} \times 100$$

Where

W_2 = Weight of the boiling flask after extraction of fat
W_1 = Weight of the boiling flask

Free fatty acid content

The determination of percentage of Free Fatty Acid content in the product was carried out at 24, 48, 72,

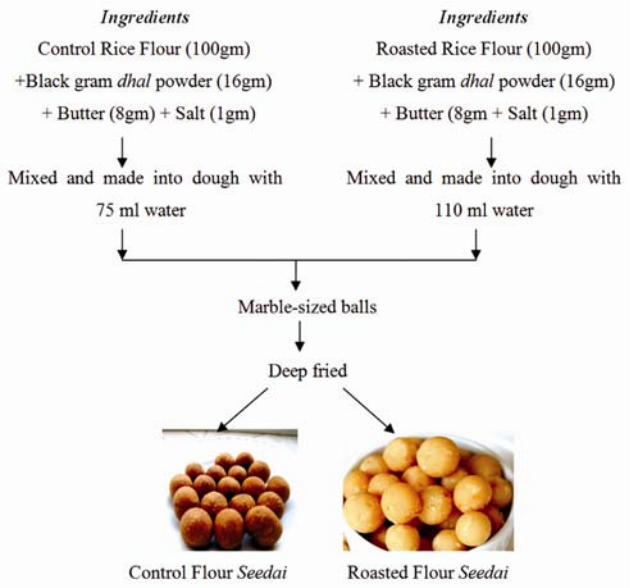

Fig. 2 - Preparation of *Seedai*

96, 120, 144, and 168 hrs[8]. The sample solution was prepared by dissolving 10 gm of sample in 50 ml chloroform. The solution was placed in an orbital shaker for 1 hour and filtered using a filter paper. 20 ml of the filtrate was pipette out into an iodine flask. 50 ml of benzene alcohol mixture was added followed by few drops of indicator solution. This was then titrated against standardized alcoholic alkali solution to a pale pink end point.

$$\text{Free Fatty Acid (\%)} = \frac{\text{Titre value x Normality of alkali x 28.4}}{\text{Weight of the sample (gm)}}$$

Sensory evaluation

The sensory evaluation of the two sets of products – control and experimental was performed using 9 point hedonic scale[9]. In accordance with the IFT guidelines[10],50 panelists were selected to discriminate and scale the different attributes of the product on a broad range. The panelists were provided with prescribed questionnaires to record their observation. The samples were placed in white plastic disposable cups, labeled and placed on benches in a way that there was no interface between the panelists. Water was provided for the panelists to rinse their mouth after each taste. Evaluation was based on colour, flavour, texture, odour and taste. Scores were based on hedonic scale of 1-9 (1 = dislike extremely and 9 = like extremely).

Data analysis

The analytical tests were performed in triplicates (n=3). Mean and standard deviation was calculated for all recorded observations. One way analysis of variance was used to determine the impact of pretreatment.

Results and discussion

Moisture content

The percentage of moisture in the control flour and the roasted flour was found to be 17.4% and 13.78%, respectively (Table 1). The moisture content of the Control flour *Seedai* was 2.7% and that of the Roasted flour *seedai* was 1.04% (Table 1). The difference in the moisture content of the two flours was due to the evaporation of moisture on roasting and which in turn reduces the moisture content of the final deep fried product[11]. During deep fat frying, the moisture present in the food evaporates and escapes. In order to maintain the vapourization, the moisture from the core of the food moves to the crust which remains permeable. The vapour leaves empty space for the fat to enter the food and thus the fat absorption is basically determined by the moisture content of the food[12]. This shows that low moisture foods absorb less fat and high moisture foods absorb more fat[13]. The amount of oil absorbed by the food is directly proportional to the amount of moisture lost[14]. Therefore, these results revealed that the moisture content of the flour has a significant effect on the amount of oil absorbed by the product.

Oil absorption and oiling off

The oil absorption of Control flour *Seedai* was 29% and it significantly decreased to 22% on pretreatment (Table 1). As the moisture was removed from the experimental flour by roasting, there was less vapourization of moisture which resulted in less oil absorption. This observation confirms the findings of a previous research which observed that pretreating the flour with dry heat reduces the fat uptake in the final fried product[15]. Drying or heat treating the food prior to frying is proved to be effective on reduction of oil uptake in several food products[16,17,18]. The initial moisture content of the product before frying is a major factor influencing the final product quality. With lower initial moisture content, lower oil content is absorbed inside the fried product[19]. Most studies have reported that the higher initial moisture content resulted in an increased fat uptake and lower initial moisture content decrease the internal volume of the food that could be occupied by oil during frying and shorten the frying time[20]. The oil absorption is due to the vapourization of moisture during frying process[21]. Similar results were found in oiling off values. The percentage decrease in oiling off was about 5% in pre-treated flour *seedai*.

Table 1—Physical and Chemical parameters of the flour and *Seedai*

Parameter	Control Flour *Seedai*	Roasted Flour *Seedai*
Moisture content of Flour (%)	17.4 ± 6.5	13.7 ± 1.6
Moisture content of Product (%)	2.7 ± 0.01	1.04 ± 0.22
Oil absorption (%)	29.64	22.41
Oiling off (gm)	0.55 ± 0.05	0.52 ± 0.03
Crude fat (gm %)	85.78	51.6
FFA % at 24 hrs	1.2 ± 0.03	0.61 ± 0.11
FFA % at 48 hrs	1.25 ± 0.02	0.76 ± 0.05
FFA % at 72 hrs	1.68 ± 0.5	1.01 ± 0.04
FFA % at 96 hrs	2.47 ± 0.04	1.74 ± 0.32
FFA % at 120 hrs	2.55 ± 0.2	1.91 ± 0.07
FFA % at 144 hrs	2.86 ± 0.61	2.16 ± 0.5
FFA % at168 hrs	3.01 ± 0.08	2.58 ± 0.45

Crude fat content

The crude fat content was 8.578 gm in 10 gm of Control flour *Seedai* sample and 5.16 gm in 10 gm of Roasted Flour *Seedai* sample (Table 1). The crude fat content of the roasted flour *seedai* was significantly lesser than the control flour *seedai*. The fat content in the experimental product was found to be lesser because the amount of fat absorption by the experimental product during frying was comparatively less than the control. The amount of oil absorbed by the Control flour *Seedai* complementing the amount of moisture present was high and, similarly, the amount of oil absorbed by the Roasted Flour *Seedai* was less due to low moisture content. In other words, the food with more moisture loss show high fat uptake. The moisture content is directly proportional to the amount of oil absorbed and the amount of oil absorbed is directly proportional to the crude fat content of the final product[21,13].

Free fatty acid content

The products were stored in polyethylene pouches for 1 week and then tested for Free Fatty Acid content in the product samples. The Free Fatty Acid at 24 hrs for Control flour *Seedai* and Roasted Flour *Seedai* were 1.2% and 0.61%, respectively while it was found to increase with the storage period (Table 1). Roasted Flour *Seedai* was found to have a gradual increase in Free Fatty Acid content. This shows that low moisture foods have lesser change in Free Fatty Acid content that high moisture foods. This can be attributed to the fact that production of Free Fatty Acid in large quantities is due to the process of hydrolysis on frying[22]. Hydrolysis is a process that occurs during frying where the frying medium reacts with moisture leading to the production of Free Fatty Acids. Therefore, high moisture foods produce more Free Fatty Acid molecules. According to the findings of previous research which reveals that the higher value of Free Fatty Acid is due to the high moisture content in the food[15]. The moisture content in control flour *seedai* was found to be 2.7% and that of roasted flour *seedai* was 1.04% and, therefore, the Roasted Flour *Seedai* sample had lower values of Free Fatty Acid as the moisture content was reduced by roasting. Traditionally *Seedai* is said to have a storage period of 1 week at room temperature. The current study also identifies that the shelf life of *Seedai* can be one week based on the changes in free fatty acid of the products.

Table 2—Hedonic scores for sensory evaluation of control flour *seedai* and roasted flour *seedai*

Parameter	Control Flour *Seedai*	Roasted Flour *Seedai*
Colour	6.1 ± 0.16	7.4 ± 1.15
Odour	4.9 ± 1.44	5.7 ± 1.04
Texture	5.3 ± 1.41	6.1 ± 1.42
Flavour	6.5 ± 1.51	6.7 ± 0.72
Appearance	6.9 ± 0.43	7.1 ± 1.64
Overall acceptability	6.2 ± 1.13	6.4 ± 1.17

Sensory parameters

The sensory scores for both the control and the experimental product perceived by the panelists were not significantly different with an exception of colour. Observation of the products by the panellists revealed that the Roasted flour *seedai* was lighter than that of the control (Table 2). This variation in colour could be attributed to the moisture loss during pretreatment of flour which in turn decreased the frying time and thereby reduces the darkening of the product[23]. The frying time depends on the amount of moisture to be evaporated, i.e. moisture content of the food is directly proportional to the frying time[24]. As there was less amount of moisture in the Roasted flour *seedai*, the time taken for the replacement of moisture with oil during frying was also less when compared to that of Control flour *seedai*. As a result the experimental product was fried sooner than the control resulting in light coloured crust. The frying time of the Control flour *seedai* was 9 minutes and 24 seconds, whereas, the Roasted flour *seedai* had lesser frying time of about 7 minutes and 11 seconds. The frying time influences the product characteristics, especially colour and texture[19]. Therefore, the high moisture content in the Control flour *seedai* increased the frying time and resulted in increased darkness of the product than the Roasted flour *seedai*.

The experimental sample exhibited enhanced odour, flavor, and textural characteristics. The enhancement of odour and flavour can be attributed to roasting[4,25]. The pre-treated rice flour develops a specific aroma through Maillard reaction during roasting[4]. The phenomenon can be described as the enhancement of antioxidants and key aroma favouring aldehyde bodies occur on roasting[25]. The higher concentration of these phenolic compounds results in browning of the flour and contributes to the characteristic flavour of roasted rice flour. The overall acceptability of the experimental product was not significantly different from that of the control.

Conclusion

Thus, the results of the study suggest dry heating as a suitable method of pretreatment for rice flour. It has a significant effect on the quality characteristics and the amount of oil absorbed by the experimental product. The crude fat content, Free Fatty Acid content and the amount of oil absorbed by the product was found to be considerably lower in the pre-treated roasted rice flour *seedai* than the control *seedai.* The reduction in the amount of oil absorbed in the experimental product enables longer shelf life. The sensory scores of the pretreated flour *seedai* were similar to that of the control. Therefore, the dry heating method can be used as a pretreatment of the rice flour for the enhanced quality of the final product.

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