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Performance Evaluation of Small Scale Rice Puffing Machine

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ABSTRACT

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The puffing machine was designed, fabricated and tested. This machine consists of blower unit, heating unit, container, casing, wooden platform and power consumption. Two types of power transmission was used in the developed machine, one from electric motor of 0.25 hp capacity for blower and the other one for heating coil connected directly to electric source. After achieving 220-250°C temperature in the container, the specified feed rate of conditioned rice in to the container will result in puffed rice within a short span of around 10-12 sec. The capacity of the small scale rice puffing machine ranges between 4-5 kg/h.

Introduction

Paddy (*Oryza sativa* L.) is second largest major cereal crop a member of grass family (Graminaceae), which produces starchy seeds. Rice is used as an important staple food by the people in many parts of the world after wheat. Puffed rice is a popular snack food product in India and has been widely produced for centuries. Reliable figures on the volume of the puffed rice production in India are not available. But it has been estimated that about 10% of rice is converted into rice food snack items. At present the puffed rice is made at cottage and semi-mechanized levels and mostly in a batch type unit.

The Food processing industry has an important role to play in linking the farmers to the final consumers in the domestic as well as the international markets. Food processing combined with marketing has the potential of

solving the basic problems of agricultural surpluses, wastages, rural jobs, and better remuneration to the growers. In the next ten years, food production is expected to double. These produces, if processed and marketed smartly, can make India a leading food supplier of the world. India with a population of 1.08 billion (growing at about 1.7 % per annum) provides a large and growing market for food products.

Food products are the single largest component of private consumption expenditure, accounting for as much as 49% of the total spending. Furthermore, the upward mobility of income classes and increasing need for convenience and hygiene is driving demand for (a) perishables and non-food staples and (b) processed foods. The processed food industry should introduce

innovative new products of high quality at low cost in small package sizes in ready to eat format to cash on this booming opportunity.

Review of literature

Chandrasekhar and Chattopadhyay (1989) developed the pneumatic rice puffing machine for increasing the production capacity of puffed rice. The physical properties of the rice grains and other fluidization parameters, necessary for this study was experimentally determined. The surface heat transfer coefficient in case of hot air fluidized bed puffing was found to be 155.39 W/m²K. The calculated grain surface temperature for puffing was about 170°C and this did not vary significantly for experimental puffing air temperatures ranging from 200°C to 270°C. the air temperature ranging from 240°C to 270°C with corresponding exposure time of 9.7 s to 7s was found to be optimum for higher expansion ratio (8.5 to 10) and better color of the product.

Mohamed *et al.*, (1993) studied the popping performance of 18 popcorn hybrids. Differences in popping quality indices between the two microwave treatments indicated a negative effect of salt on popping. Pericarp thickness gave highest correlation with expansion volume in microwave and conventional popping while, sphericity correlated slightly better in unsalted microwave popping.

Malleshi and Desikachar (1981) studied the effect of various processing conditions to determine the optimum conditions. Optimal conditions for puffing of ragi were moistening to 19 per cent moisture and equilibration for 4 hr, followed by puffing in sand medium to 270°C. Wide varietal variation has been found in the puffing quality, among the fourteen varieties studied. No consistent relationship was observed between the grain in amylose,

protein content or thickness of bran with puffing quality.

Suchada Maisont and Woatthichai Narkrugsa (2010) reported the effects of salt, moisture content and microwave power on the puffing qualities of puffed rice were investigated. Paddy rice was adjusted with water and 2% salt solution at four moisture levels 10, 13, 16 and 19% (w.b) and puffed with microwave power at 600, 700 and 800 watts. The results showed that all the main factors and their interactions significantly ($p < 0.05$) affected the puffing qualities of total puffed yield, fully puffed yield, small puffed yield, expansion volume, texture, color and microstructure.

Materials and Methods

Development of small scale rice puffing machine

Based on the reviews collected on the rice puffing technology, the operational parameters considered for the development of small scale rice puffing machine are as follows.

Blower unit for blowing the heated as well as to maintain terminal velocity of rice for exposing them throughout its surface to the heated container for rice to be get puffed.

Heating unit for maintaining the temperature at around 200-250°C.

Container having slots all along its periphery at the bottom to create air current for rotating rice in order to expose them to the heated container.

Casing to surround blower, heating unit and the container.

Plat form to fix all the accessories of the puffing machine.

Power transmission for transfer of electrical power from the source to the equipment. developed small scale rice puffing machine is shown in plate 1.

Operational procedure of small scale rice puffing machine

The assembly of different accessories of small rice puffing machine include, blower unit, heating unit, container and casing. All were fitted on the wooden platform as shown in plate.6

The developed small scale rice puffing machine operates through two power sources. The one which is used to run the motor (0.25 hp) fitted to the impeller for getting desired rpm and the other source was the external electrical power source to heat the coil for getting desired temperature. Some of the operational parameter considered for rice puffing from the developed machine was as follows.

Impeller speed, rpm
Heating temperature, °C
Container design,
Casing design

The development of rice puffing machine was done by keeping the optimum operational parameters of rice puffing technology.

The Motor and the impeller was selected/designed so as to get the desired air velocity to roll force the rice placed in the container to run all along periphery for getting maximum area exposed to the heat source. The container design was also aimed for proper size and shape of slots so as to get the desired air flow through the slots for moving the rice placed in the container.

After switching on the electrical heating source wait for some time till getting desired

conduction heating temperature of the container and then the blower unit has to be switched on. When the conditioned rice is placed in the container, the rice will get puffed with in specified time and comes out of the container.

Conditioning of rice before used for puffing in rice puffing machine

Conditioning of rice prior to the puffing operation is an essential requirement for getting puffed rice. The rice conditioning process flow chart adopted during the study is presented below.

Performance evaluation of rice puffing machine

The designed and fabricated machine was tested to evaluate its performance on the basis of its capacity and puffing quality.

The puffing capacity of the machine was determined by feeding the conditioned rice in to container to puff it within a period of minute and then the puffed rice was weighed in order to determine the capacity and puffing quality.

Results and Discussion

Puffing quality

The results of the parameters considered under puffing quality of puffed rice are as follows.

Taste

The general acceptance of consumer for regular usage is considered in respect of taste. It was found that no significant difference was noticed with respect to taste. Taste is mainly characterized by the quantity of salt solution used and the stickiness during mouth feel.

Expansion ratio

The expansion ratio observed for IR-64 rice variety which is normally used in Raichur for both the methods are almost similar. The expansion ratio of the IR 64 was observed as 12.5. The expansion volume of puffed rice soaked in salt solution was more as compared to rice soaked in tap water. The expansion volume of puffed rice was higher when the moisture content increased from 10 to 13%, but was lower when the moisture content was 16 and 19 % (Suchada *et al.*, 2010). Expansion ratio of puffed rice is influenced by the amylase content of rice, salt solution treatment and the length-width ratio. As the

length width-width ratio increases, the expansion ratio also increases. Higher the amylase content in the rice influenced the higher expansion ratio.

Product hygienic condition

The product hygiene observed for the puffed rice obtained from both the methods were observed. It was found that the dissolved solids obtained after soaking of puffed rice from manual method is less as compared to mechanical method. This may be due to exposure of puffed rice to a high degree of dust generated during pressure feeding of saw-dust in mechanical rice puffing methods.

Plate.1 A view of small scale rice puffing machine



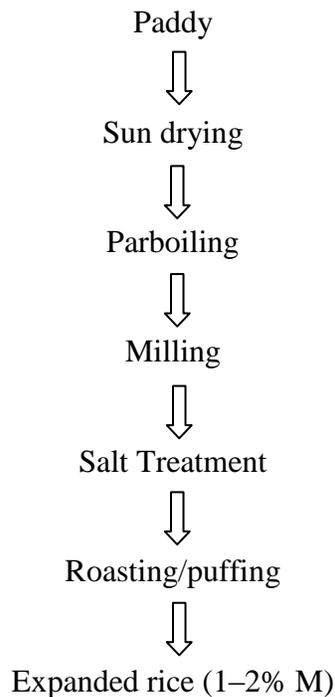
Table.1 Evaluation parameters of small scale rice puffing machines

Description	Small scale puffing machine
Capacity	5 kg/day (5h)
Labour requirement	1
Temperature in puffing	220-250 ⁰ C
Expansion ratio of rice	9.4
Storage life	2 months

Table.2 Cost of operation of small scale rice puffing machine

Description	Values
Total cost of operation per hour	102.53
Total puffed rice per hour	1 bag
Total cost of puffed rice	120
Net profit	20
BC Ratio	1.17

Fig.1 Process flow chart for conditioning of rice



Storage life

As per the consumers of puffed rice opinion the storage life prepared from both the methods *i.e.* manual and mechanical methods was about 2 months with respect to crispiness and cooking quality is concerned. Some of the quality parameters of the puffed rice and the cost of operation are presented in tables 1 and 2.

This machine is simple in construction and easy to operate. The capacity of the small scale rice puffing machine ranges between 4-5 kg/h. One labour is enough for operation of

machine as well as other activities. The drudgery involved during operation was almost nil as compared to traditional rice puffing methods. With respect to environmental safety concern, the puffing operation from small scale rice puffing machine was completely safe because it uses electric power source and no emission of any harmful gases.

References

Chandrasekhar, P.R., and Chattopadhyay, P. K., 1988. Heat transfer during fluidized bed puffing of rice grains, *Journal of*

- Food Process Eng.*, 11: 147–157.
- Malleshi, N.G., and Desikachar, H. S. R., 1981. Varietal differences in puffing quality of ragi (*Elusine coracana*). *Journal of Food Science and Technology*, 26: 26-28.
- Mohamed, A.A., Ashman, R. B and Kirleis, A. W., 1993. Pericarp Thickness and Other Kernel Physical Characteristics Relate to Microwave Popping Quality of Popcorn. *J. Food Sci.* 58:342-346.
- Suchada Maisont, and Woatthichai Narkrugsaa., 2010. Effects of salt, moisture content and microwave power on puffing qualities of puffed rice, *Kasetsart J. (Nat. Sci.)* 44: 251 – 261.

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