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PERFORMANCE EVALUATION OF GARLIC CLOVE PEELER

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Abstract:
After onions, garlic is the Allium that is used most commonly. The edible component of this plant is a complex bulb. It has been used for a number of food preservation techniques in India and other central eastern nations. There is a large amount of garlic that is typically eaten as peeled cloves. Traditionally, garlic cloves are separated and peeled using hot water, flame, oven, crushing and shaking methods. It takes a lot of time and labor to use these conventional methods. The current study was conducted at a commercial peeled garlic supplier close to Fatehpura, Mandvigate, and Vadodara. The garlic peeler is made up of the feed hopper, vertical cylinder, compressor unit, cleaning and discharge equipment, and main frame. The garlic peeler was evaluated with three Feed rate levels: 72, 108 and 144kg/h. According to observation and calculations the optimum performance was noticed at108 kg/h feed rateover all other treatments where avg. peeling efficiency was obtained86.28% as well as minimum damage to the garlic cloves.

Key Words Efficiency, Sphericity,Garlic peeler, Performance evaluation

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Introduction:

The spice of life, garlic (Allium sativum L.), is one of the most significant perennial bulb crops in the lily family (Lilaceae). It is used all over the world as a spice or condiment. Garlic is a great source of phosphorus, proteins, and carbs. According to USDA data from 2019, raw garlic typically includes 58.6% water, 149 kcal of calories, 33.1 g of carbs, 6.36 g of protein, and 2.1 g of total dietary fibre. Allicin, a compound found in garlic, possesses antibacterial, antibiotic, and antioxidant effects (Augusti, 1996). After onions, garlic is the Allium that is used most frequently. Garlic is used as a flavour or condiment all over the world due to its strong and spicy flavour.

Garlic is grown on 354000 hectares of land and is produced in 2836000 metric tonnes in India, with an average yield of 0.12 t/ha in 2018–19 (NHB, 2018–19). Bulb breaking, peeling,

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dehydration, grinding, and other unit processes are all part of the processing of garlic. One of the most crucial and fundamental key unit processes before any further processing is garlic peeling. The segments of garlic must have the thin, inedible layer of membranous skin peeled off. Due to the typical size of the cloves, peeling takes a lot of effort and time. In the kitchen, peeling garlic can lead to broken nails and finger irritation (Mudgal 2005; Singh et al., 2022).

Some physical characteristics of the garlic bulb and its segments that are important for the mechanisation of garlic processing (Haciseferogullari et al., 2005). The traditional methods for peeling cloves, such as hand peeling, flame peeling, oven peeling, and chemical peeling, are very labor-intensive and time-consuming (Dhananjay et al., 2015). The peeled garlic cloves are also used to make value-added products including dehydrated garlic, garlic powder, paste, and peeled garlic, among others. Peeling garlic cloves is a crucial step in the processing of garlic since it increases productivity.

Therefore, a powerful peeling tool is needed to carefully remove the skin off a garlic clove without damaging its shape, structure, or aroma. The creation of a machine-operated garlic peeler was the focus of numerous studies. Due to the high demand for peeled garlic cloves, a mechanical garlic peeler was created, and its performance was assessed.

In their 2011 development of a low-cost garlic clove peeler observed a peeling efficiency of 97.6% with a peeling time of 70 s for a batch of 500g (Mudgal, et al., 2011) .With a machine throughput capacity of 27 kg/h and an energy requirement of 1.15 kw-h, research determined peeling efficiency, yield of peeled and unpeeled garlic, damage, and peel separation were 86.6, 86.2, 4.7, 9.15, and 96%, respectively. Compared to hand peeling garlic, a garlic peeler saved INR 16.11/kg (94.99%) and 1.63 (97%) man hours (Manjunatha, et al., 2014).

The peeling effectiveness of garlic increases with decreasing disc speed and number of fins, according to research evaluation of a prototype peeler for both kinds using varied numbers of fins (1, 2, and 3 fins) and disc speeds (1600, 1800, and 1400 rpm). At 1600 rpm, the best peeling efficiency was attained, and red garlic had 85.1% of the white garlic's 1 fins compared to 57.6% for red garlic (Badr, 2017). The maximum peeling efficiency was observed to be 48.14 % for hot air pre-treated samples at 400 rpm of roller speed and minimum to be 33.89% for control samples, while the maximum peeled clove recovery calculated was 39.40 % for hot air pre-treated samples at 400 rpm and minimum of 27.50% at 300 rpm for control samples in small-scale garlic peeler (Kaur et al., 2019).

For rotating disc type machine for peeling garlic cloves, researcher discovered that it used 0.73 kWh of total energy and 0.049 kW/kg of specific energy. The rotating disc type garlic peeler's estimated peeling effectiveness was 89.43% (Singh et al., 2022).The prototype garlic clove peeling machine was evaluated with an average feed rate of 2.63 kg/h and an average actual output capacity of 1.87 kg of healthy, fully peeled garlic cloves per hour. When compared to manual peeling of garlic, average peeling efficiency was discovered to be 71.11%, saving 60% of labour and time (Rai et al., 2022).With a motor speed of 650 rpm and a processing interval of 20 s, researcher developed a garlic peeling machine and obtained the highest intact garlic yield. The combined weight of intact and damaged garlic was 179.5 g, or 89.76% of the total weight of the garlic, and 230.86 g, or 76.95% of the total weight, respectively (Whangkuanklang et al., 2023).

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Materials and Methods

Traditionally, there are several methods used to peel garlic cloves: flame peeling, oven peeling, crushing technique, hot water technique, and shaking technique. These methods are all labour-intensive and ineffective. The garlic clove peeler was made to solve this issue.

Place of Work

The present work was carried out at Food Processing Laboratory at PIT, ParulUniversity.Commercial supplier of peeled garlic nearby Fatehpura, Mandvigate, Vadodara has sent this garlic peeler for research work.

Selection and Procurement of Garlic

The garlic cloves of cultivar GG-4 were selected for the study as it has been widely grown by the farmers of Gujarat is shown in figure 1. The well matured, cured, sound and healthy garlic cloves were procured from raw material availablewith commercial supplier of peeled garlic. The procured materials were packed in a bag and kept in storage until use. For the experiment, we select 50 cloves randomly of GG4 cultivar. The overall size of selected garlic cloves is given in Table 1 and figure 2. The equivalent diameter of selected garlic cloves wasin range of 6.75 mm to 14.37 mm. The mean equivalent diameter of garlic clause was obtained as 10.36 ± 1.72 mm. The weight of randomly selected clove was measured in ranged of 0.2 to 1.5 g having weight of 0.698 ± 0.289 g. Bulk density of garlic cloves was varied from as 0.499 g/cc to 0.505 with a mean value of 0.502 g/cc. The terminal velocity of selected garlic clove was varied from 7.7 to 8.5 m/s with mean value of 8.1 m/s. The Angle of repose of garlic segments was measured by freely falling of the garlic from certain height and making the cone until its height was become constant. The height of cone and diameter of the cone were measured by scale. It was varied from 34.99º to 42.41º with mean value of 38.36º.

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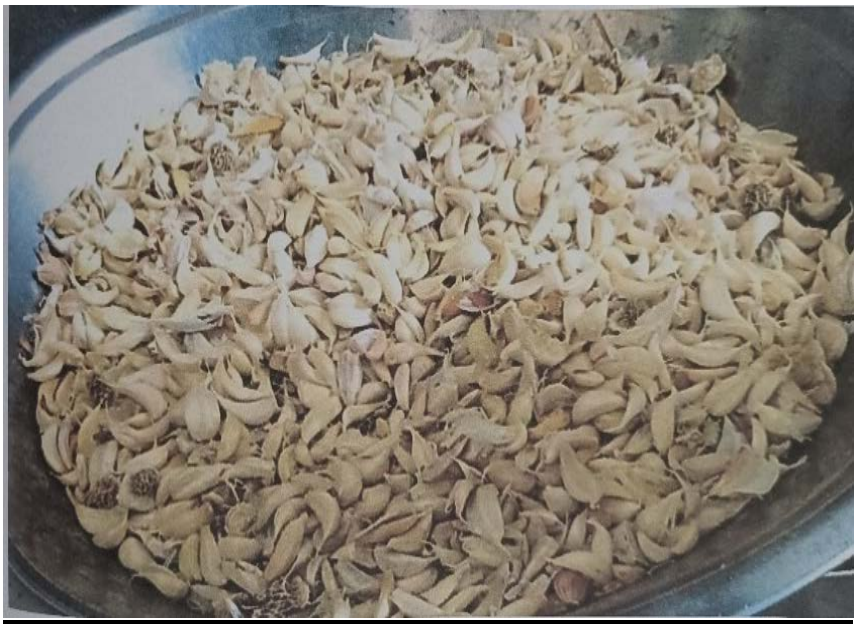

Fig. 1. The garlic cloves of cultivar GG-4

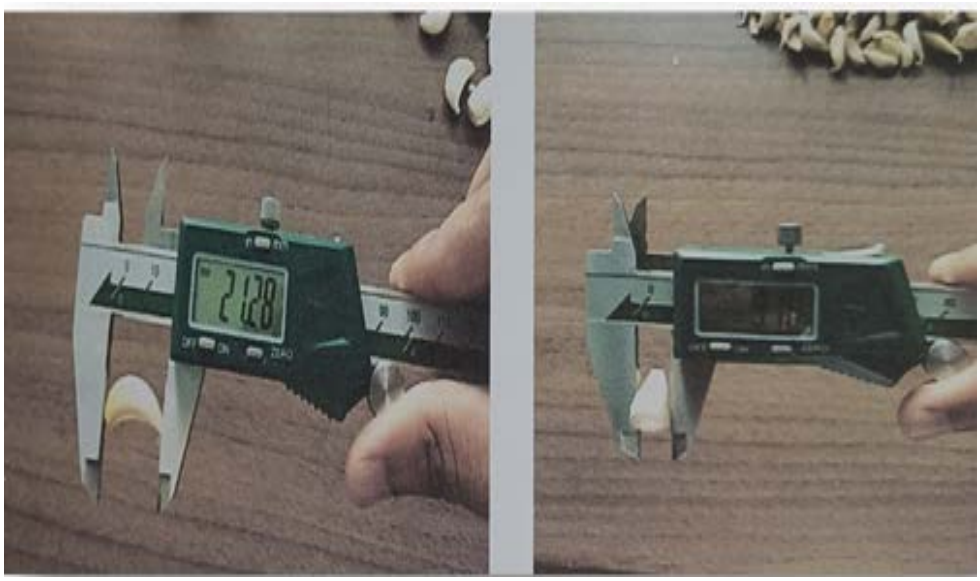

Fig. 2. Measurement of overall size of selected garlic cloves

Table 1:-The overall size of selected garlic cloves

	Length(mm)	Width (mm)	Thickness(mm)	Equivalent Diameter, (mm)	Sphericity
Min	15.11	4.74	4.30	6.75	0.45

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Max	27.95	12.26	9.33	14.37	0.53
Mean	21.17	7.79	6.76	10.37	0.49
S.D.	2.50	1.61	1.27	1.72	0.69

Constructional Detail of the Garlic Clove Peeler

The existing garlic clovepeeler was consisting mainly of a circular feed hoppermounted on cone shape unit, diameter of hopper was 450 mm. cone shape unit has upper diameter of 450 mm whereas bottom diameter of 150 mm and vertical cylinder connected with it was having height of 350 mm and diameter 150 mm. The photographic view of Garlic peeler is presented in fig. 3.

Fig.3. Photographic view of Garlic peeler

Experimental Procedure

The machine was thoroughly cleaned and overhaul for smooth and trouble free operation and thereafter a preliminary trial was taken. During the trial, the operation as well as the quality of output was critically observed and required modifications were decided. After doing predetermined modifications performance evaluation of the garlic clove peeler was carried out.

Assessment of the efficiency of the garlic peeler

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The machine efficiency was measured across the feed rates of 72, 108 and 144 kg/h. One kilogram of sample for each test combination were feed into the parabolic hopper. The evaluation of each of the parameters was repeated three times before the values were averaged. The final weight of peeled garlic cloves was calculated by following Equations:

W_p (g) =W_t (g)- W_u (g) - W_d (g)

The following formula was used to calculate the peeling efficiency as suggested by Sharma and Madhyan (1988).

Peeling efficiencyη (%) = (1- W_u/ W_t)× (1- W_d/ W_t) × 100

Where, W_t (g) = Initial total weight of

W_p (g) = weight of intact peeled garlic cloves

W_d (g) = weight of damaged garlic cloves

W_u(g) =Weight of unpeeled or slightly peeled garlic cloves

Results &Discussion

The garlic clove peeler was evaluated with three different Feed rate levels: 72,108and 144. The observations recorded for various treatment combinations for optimizing the feed rate for obtaining maximum intact peeled clove efficiency and machine output capacity were analyzed by using two factors Completely Randomized Design with three replications. The analyzed data was presented in table 2.

Table 2:-Analyzed data showing the effect of cylinder speed and feed rate on separation of garlic cloves.

Treatment	Replication	Feed Rate (kg/h)	Weight of Peeled Cloves (g)	Weight of Unpeeled Cloves (g)	Weight of damaged Cloves (g)	Weight of Light Materials (skin) (g)	Peeling Efficiency (%)
T_1	R_1	72.00	700.20	95.00	150.00	54.80	76.93
	R_2	72.00	685.80	90.30	165.65	58.25	75.90
	R_3	72.00	696.10	89.00	158.30	56.60	76.68
	Avg.	72.00	694.03	91.43	157.98	56.55	76.50
T_2	R_1	108.00	780.30	85.70	62.37	71.63	85.73

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	R_2	108.00	777.50	88.88	65.90	67.72	85.11
	R_3	108.00	782.30	82.70	59.37	75.63	86.28
	Avg.	108.00	780.03	85.76	62.55	71.66	85.71
T_3	R_1	144.00	652.80	170.00	135.00	42.20	71.80
	R_2	144.00	660.00	165.30	129.00	45.70	72.70
	R_3	144.00	662.00	158.16	131.62	48.22	73.10
	Avg.	144.00	658.27	164.49	131.87	45.37	72.53

Effect on peeling of clove

As shown in fig.4, the minimum avg. efficiency of clove peeling (72.53 %) was recorded in the treatment T_3 and maximum avg. efficiency of clove peeling (86.28 %) was noticed in the treatment T_2.

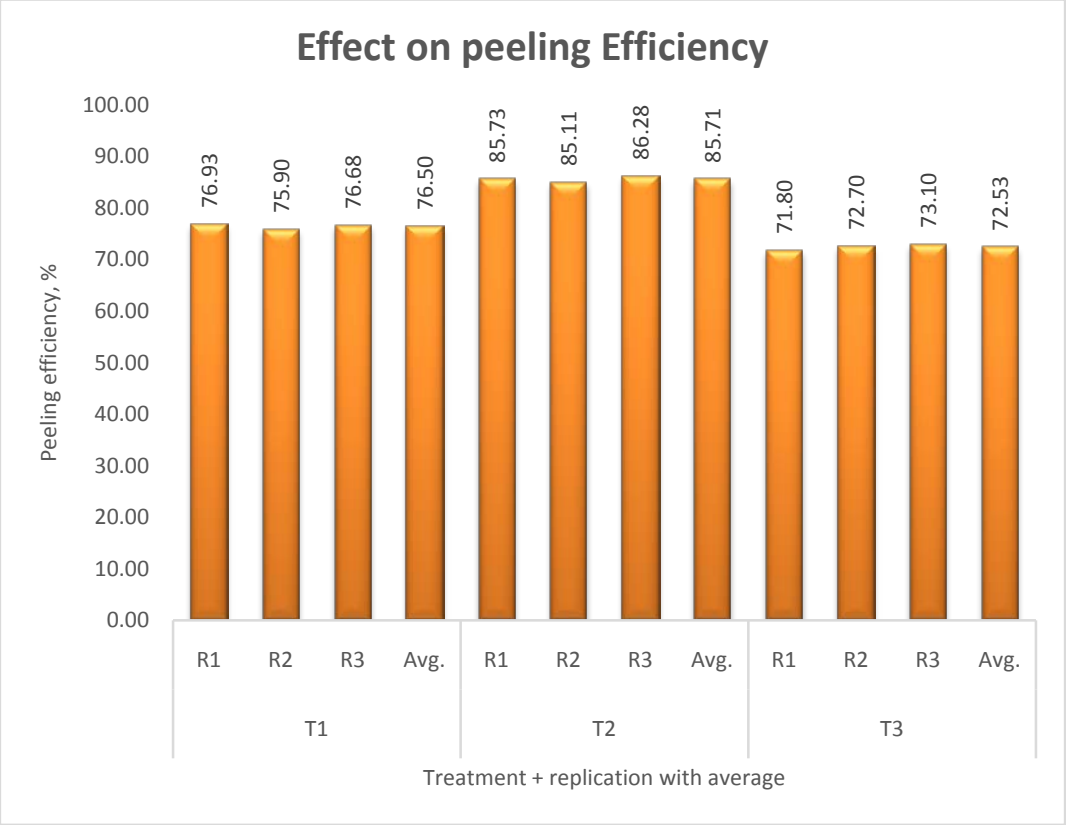

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Fig. 4 Treatment wise peeling efficiency

Effect on damage of cloves

From the fig. 5, it was seen that the weight of damaged garlic cloves was higher for treatments T_1 and T_3 as compared to treatment T_2. However, it was noticed that there was maximum damage of cloves in T_1.

In treatment T_1R_1, the weights of peeled cloves, unpeeled cloves, damaged cloves, and light material were 700.20 g, 95.00 g, 150.00 g, and 54.80 g, respectively, and the peeling efficiency was 76.93%.In treatment T_1R_2, the weights of peeled cloves, unpeeled cloves, damaged cloves, and light material were 685.80 g, 90.30 g, 165.65 g, and 58.25 g, respectively, and the peeling efficiency was 75.90%.In treatment T_1R_3, the weights of peeled cloves, unpeeled cloves, damaged cloves, and light material were 696.10 g, 89.00 g, 158.30 g, and 56.60 g, respectively, and the peeling efficiency was 76.68%.

In T_2R_1, the weights of peeled cloves, unpeeled cloves, damaged cloves, and light material were 780.30 g, 85.70 g, 62.37 g, and 71.63 g, respectively, and the peeling efficiency was 85.73%.In T_2R_2, the weights of peeled cloves, unpeeled cloves, damaged cloves, and light material were 777.50 g, 88.88 g, 65.90 g, and 67.72 g, respectively, and the peeling efficiency was 85.11%.Weight of peeled cloves, weight of unpeeled cloves, weight of damaged cloves, and weight of light material were 782.30 g, 82.70 g, 59.37 g, and 75.63 g, respectively, in treatment T_2R_3, and peeling efficiency was 86.28%.

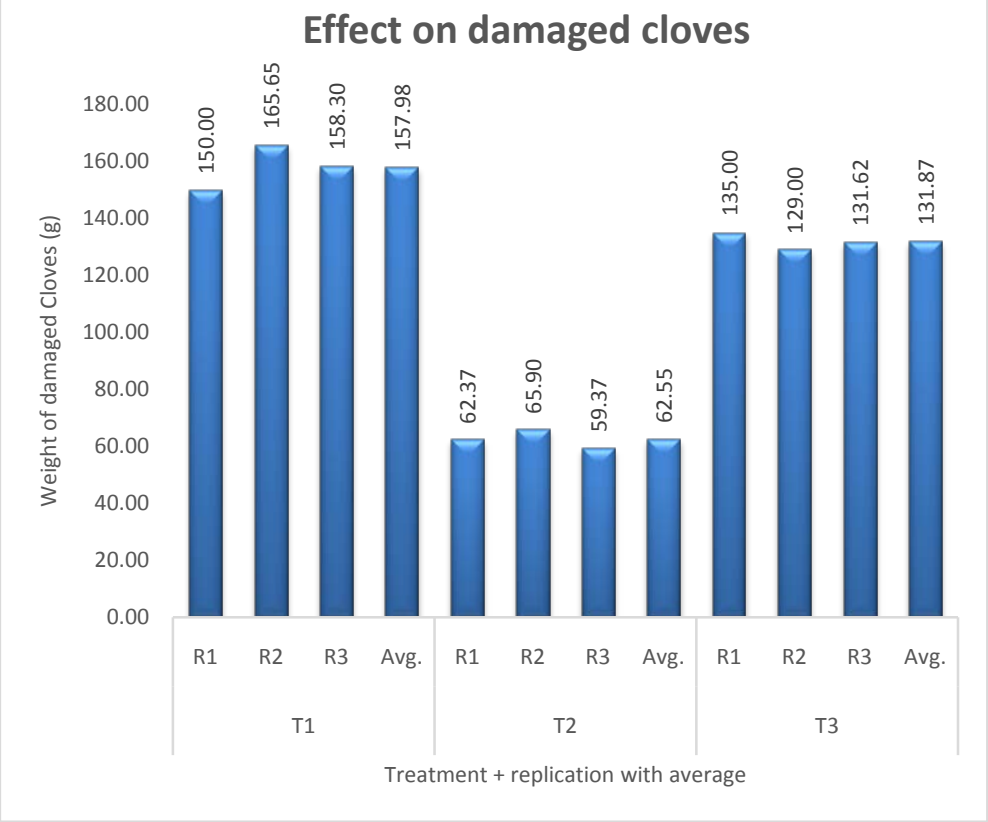

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Fig. 5 Treatment wise damaged cloves obtained

In treatment T_3R_1, the weights of peeled cloves, unpeeled cloves, damaged cloves, and light material were 652.80 g, 170.00 g, 135.00 g, and 42.20 g, respectively, and peeling efficiency was 71.80%.In T_3R_2, the weights of peeled cloves, unpeeled cloves, damaged cloves, and light material were 660.00 g, 165.30 g, 129.00 g, and 45.70 g, respectively, and the peeling efficiency was 72.70%.In T_3R_3, the weights of peeled cloves, unpeeled cloves, damaged cloves, and light material were 662.00 g, 158.16 g, 131.62 g, and 48.22 g, respectively, and the peeling efficiency was 73.10%.

Following onions, garlic is the most commonly utilized Allium. A complex bulb is the edible component of this plant. It has been used for a variety of food preservation processes in India and other Central Eastern countries. Garlic is usually consumed as peeled cloves, and there is plenty of it. Garlic cloves have traditionally been separated and peeled using hot water, a flame, an oven, crushing, and shaking. Using traditional methods takes a significant amount of time and work. The current study was conducted at a commercial peeled garlic supplier in the Fatehpura area of Vadodara. The garlic peeler is comprised of the feed hopper, vertical cylinder, compressor unit, cleaning and discharge equipment, and main frame. Three feed rates for the garlic peeler were tested: 72, 108, and 144 kg/h.The optimum performance was found at a feed rate of 108 kg/h over all other treatments, with an average peeling efficiency of 86.28% and no damage to the garlic cloves, according to observations and calculations. This technique saves time and money for farms, preservative industries, cloud kitchens, hotels, and restaurants.

Conclusion

Accordingly, it can be concluded from the current experiment that a garlic peeler operating at an effici ency of 86.28% and a feed rate of 108 kg/h may produce the best intact peeled garlic cloves with the l east amount of damage.

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