



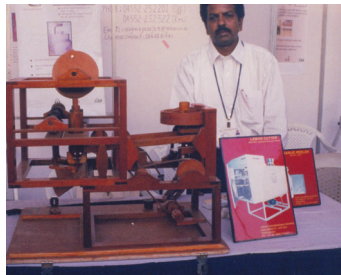
Lemon cutting machine and garlic peeling machine⁶

FARM MACHINERY - AGRI PROCESSING NATIONAL THIRD

M. Nagarajan (45) lives at Usilampatti, a small village 40 km away from Madurai in Tamil Nadu. He has studied up to ninth standard. He is married and has two children. Being the eldest in the family, he supported the education of his younger brothers and sisters and also got them married. He is the sole bread-winner of the family. His dream is to develop such machines related to food processing which are not available in the market. M. Nagarajan has modified a garlic-peeling machine and a lemon cutting machine significantly. These improved machines address the two-fold problem of the pickle industry, namely, inefficiency due to low degree of automation and short supply of labour during peak seasons, which limits the capacity.

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Genesis Nagarajan owns a small scale lathe workshop named Virgo Industry. The factory has been manufacturing accessory parts like aspirator, destoner, heat reducer and grinder used in the rice hulling units for the past 17 years. It operates from a very small and old rented house. Virgo Industry was founded by Nagarajan's late father who used to provide support services to the nearby rice mills. But over the last few years, continuous drought affected not only the farmers but also all the dependent industries. Most of the rice mills in the nearby areas have closed down. These circumstances forced the entrepreneur to seek some other avenues for survival. Nagarajan's close interaction with the pickle manufacturers exposed him to the problems prevailing in the industry. Some of the local pickle manufacturing companies requested him to design and develop a system to peel off garlic for making garlic pickles. Nagarajan successfully designed and developed a garlic-peeling machine in 2002 after two

years of hard work. Later, he developed a lemon cutting machine as well.

Garlic peeling machine

The garlic peeling machine consists of a 2 HP electric motor, blowers, a peeling chamber, inlet, outlet, exhaust pipe and drives. The peeling chamber has a provision for garlic inlet and a shaft on which the blades are arranged in such a manner that there are six rows and each row consists of four blades placed at an equiangular distance of 90 degrees. The blades are arranged in two consecutive rows. In one row, the blades intersect vertically and horizontally, and in the other row, the blades intersect diagonally. The peeling chamber is cylindrical and the internal walls are serrated. The drives consist of three shafts and pulleys and are transmitted with the use of V-belts. The machine consists of two blowers of different sizes. A housing, made of a steel sheet, covers the entire mechanism. The manufacturing cost of a single prototype

is Rs.52,000 inclusive of labour charge and other running costs.

How the machine works

The garlic is fed into the peeling chamber through the inlet chute. Power is transmitted from the two HP motor shafts through V-belts. The pulley, fitted on the shaft, rotates the small blower. Pressurized air from the small blower removes the excess moisture from the garlic on the way to the peeling chamber. The cloves entering



the peeling chamber are pushed by the pressurized air from the big blower to the rotating blade. The rotating blades hit the garlic cloves towards the serrated wall of the peeling chamber and there these get peeled. At the same time, the pressurized air from the big blower pushes out the dust and the skin of the garlic cloves through the exhaust pipe. The peeled garlic cloves from the peeling chamber are collected through the outlet

by gravity.

Advantages

The machine has the capacity to peel 200 kg of garlic cloves/hr. The garlic cloves thus obtained are of uniform size and can be neatly and conveniently collected and recovered. Another feature of this machine is that it is easy to construct, operate, and maintain. The machine helps to achieve greater productivity, is energy efficient and labour saving and reduces the drudgery in the slow laborious manual process of peeling garlic. It can also be used in other food processing industries apart from the pickle industry.

Lemon cutting machine

The Innovation

This innovative machine can continuously cut large quantities of lemon into required shapes and sizes. The machine includes two fixed hoppers - one conical and another circular, both having two outlets. When a taper disc, fitted in the circular hopper rotates, it makes the lemons move forward through a passage one by one. This passage is in the shape of a channel, which has the provision of a chain control regulatory mechanism in the centre. This serves as a gripping system and ensures the movement of lemons subsequently into the cutting system. Before the lemon is cut into eight pieces, there is a mechanical regulatory mechanism, which so opens and shuts the inlet chute that the lemons are cut in sequence. In the cutting chamber, the lemon is placed on the upper side of a multi edged cutter with four edges facing four directions and fixed in position.

Subsequently, a plunger, which is fitted above, moves vertically to press the lemon to the cutter and the lemon is cut without the shape being destroyed. The lemon is cut into four slices with a single stroke of the plunger and in the next movement there is a diagonal cut that divides one entire slice into two. Thus, a total of eight slices come through the outlet.

This machine is capable of cutting lemons ranging in size from 0.75 inches diameter to 2.5 inches diameter

with the help of a spring loaded mechanism which also provides a better grip on the lemon which ensures uniformity in cutting. For packaging in smaller



quantities, the lemon has to be cut into smaller pieces (12 to 16 pieces). Changes can be made in the present machine to do this as well as to grade the lemons. This results in lower cost of production.

Advantages

The slices of fruit produced by using this machine are of a uniform size and can be neatly and conveniently collected and recovered. Optimized power transmission ensures less consumption of electricity (7-8 units in 8 hours of operations). This device is labour saving - only one person is required to operate it. There is a minimal wastage of the lemons in the cutting operation i.e. 100% of the yield is utilized. The machine is compact and made of stainless steel, which makes the process hygienic. The half CAM lever mechanism in the machine ensures that the lemons are fed to the cutting chamber one by one to avoid cluttering and this ensures proper cutting of the lemons. The

synchronization of the movement of the four-edged vertical blade and rotary horizontal blade ensures that the lemon is cut right across both the axes and this ensures removal of seeds without any effort. This feature not only saves manpower costs and wastage due to improper cutting, but also contributes to the quality of pickles (seeds in pickles often cause irritation to the consumer). The cutting capacity of this machine is 160 lemons/ minute or 450 kg per hour. This innovative technology has an edge over two other manufacturers, who make similar machines, in terms of the low initial investment (Price-Rs.100,000) and low operating cost. This machine is also easier to operate and maintain than existing alternatives.

From the social benefit perspective, the technology offers a less hazardous process for labourers, usually women, who spend a considerable amount of time in cutting the lemon manually to the required shape and size. They often suffer from blisters on the skin while handling lemons as these are highly acidic.

According to Nagarajan, the manufacturing cost of a single prototype is Rs. 82,000 inclusive of labour charges and other costs. His selling price is Rs. 95,000.

Recognition from the formal sector

Nagarajan finds the whole experience of innovation very inspiring and feels that this spurs him on to innovate further. Contrary to the experiences of most grassroots innovators, Nagarajan's innovations were accepted and appreciated for their commercial value by industry sources. S. Kulwant Singh, (General Manager-Operations), The Food Division of Cavin Kare mentions that they purchased two garlic peelers from him and these are working satisfactorily. They are now planning to purchase the lemon cutting machine for their pickle processing unit at Gudur. They believe this will save a lot of manual labour and improve hygiene as well. CavinKare is also encouraging and supporting Nagarajan's R&D efforts in other areas of food-processing. Its technical team from Chennai had visited Nagarajan's small workshop at Uslampathy on quite a number of occasions. CavinKare is a company which

was started with Rs.50,000 and its MD Mr.C.K. Ranganathan was the recipient of this year's *Economic Times Entrepreneur of the Year award*.

Industry Analysis

Pickle manufacturing is a very labour intensive industry. The major reason attributed to this could be the prevailing small scale of the process of preparation of pickles. Most of the over 500 pickle manufacturers spread across the country, with major concentration in South India, operate at either the cottage, small or tiny industry scale with a few exceptions. The consumption pattern is also skewed towards South India. Of late, the export of pickles has witnessed a rapid growth primarily due to the increasing demand from Indian diaspora around the globe and increased awareness about Indian cuisine and accompaniments in Western countries.

The industry is labour intensive. Even a small scale pickle manufacturing unit would on an average employ about 400 women. On the positive side, the industry has provided significant employment for rural and semi-urban women. However, low automation causes inefficiency and hence, makes processing expensive. Another important feature is the seasonality in pickle manufacturing. The season is during April-June and September to mid- December. It is observed very often that availability of labour becomes the limiting factor for the industry during the season.

Current Status

The market research conducted by NIF reveals that the pickle industry is very keen to adopt these devices developed by Nagarajan due to their low initial cost and high efficiency. Since this industry is concentrated in South India, Virgo Industry may have some additional

locational advantage over other suppliers. Nagarajan had already given a few Garlic Peeling Machines for testing at the consumer end. He was also advised by GIAN on ways to protect the intellectual property rights of his new improved model. In fact, he also sensed the problem of his technology being copied by some fabricators in the region, and he stopped the sale of the earlier lemon-cutting machine. He requested NIF through its regional collaborator Sustainable- agricultural and Environmental Voluntary Action (SEVA) to file a patent for these two machines. Now, since both the patents have been filed by NIF, he is willing to take his innovations to market. NIF has also sanctioned Nagarajan a sum of Rs. 1,87,000 from the Micro Venture Innovation Fund for the commercialization of the Lemon Cutting Machine and after successful commercialization Rs. 15,000 has been repaid by the innovator as the first instalment.

In addition, parallel efforts are being made for technology licensing. But the only limiting factor is the capacity of Virgo Industry which is quite small. It can manufacture only three lemon- cutting machines or four to five Garlic Peeling machines a month. Nagarajan has a small team of five people. Two of them are trained (Industrial Training Institute) and the others are semi-skilled. The challenge is that the innovator recognises the constraint and wishes to explore other opportunities of scaling up through joint ventures or licensing.

There are several lemon cutting machines and garlic peeling machines already sold around the world. The Chinese and Korean machines are cheaper than US machines. But Nagarajan's machine is more cost effective compared to all Indian and imported machines. There lies his competitive advantage, which might generate greater success for him in future.