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RESEARCH PAPER

Process of making a new product- Non-Veg extruded chips industrially

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Abstract

The research was conducted to develop a unique product - non vegetarian wafer based on prawns. Prawns are fresh water crustaceans which are deep fried with starch and other ingredients. The product was made as an extruded snack product having very high protein content in different shapes like shell, twisters. Different process parameters were studied and it was found that ideal temperature of the extruder was optimized as 120-135°C at centre. Optimum oven speed and temperature were 30 rpm and 90-95°C respectivily while 210°C was the optimum temperature for 8-10 seconds. Along with the process and the product formulation, a flavor which complemented the taste of the sea food and enhances the product acceptability has also been developed. Some additives were identified which could enhance the palatability of productby making it crispy and non-sticky. As the taste and aroma of prawns were very strong, seasoning was chosen in such a way that the after-taste of prawns was supressed.

Keywords: Extrusion, prawns, non-veg chips, wafer, seasoning, flavor

Demand of extruded products is continuously increasing since the last two decades (Brennan, 2013). The consumption of extruded foods is not only for appealing increased nutrition but also for taste. The prawn production in India forms about 15% of the total world production of prawn and shrimps (http://www.indiaagronet.com, 2014). If the substantial productions from brackish waters, paddy fields lakes and estuaries, etc. are taken into account, the contribution of Indian production to the world production of marine prawns will be about 20% (http://www.indiaagronet.com, 2014).

Essentially there are two types of prawns -fresh water and brackish water. Prawns and shrimps are an extremely good source of protein, yet are very low in fat and calories, making them a very healthy choice of food (Ravichandran *et al.* 2009). Although shrimps and prawns have high cholesterol content, they are low in saturated fat, which is the fat that raises cholesterol levels in the body and thus, is undesirable. So, eating prawns could be advantegeous.

Meat and dairy products are no doubt sources of protein but they tend to be very high in calories and saturated fat (http://www.hsph.harvard.edu, 2014). A shrimp contains almost half the recommended daily protein needed but only have 112 calories and less than 1g of fat. Both Shrimps and prawns contain a considerable quantity of omega-3 fatty acids, which help prevent cardiovascular disease. Besides this, prawns and shrimps also have high levels of vitamin B_{12}, zinc, iodine, phosphorous, potassium, selenium and iron but smaller quantities of calcium, magnesium and sodium (Dayal, 2013).

In the development, extrusion technology is being employed to develop ready-treat products (Brennan and Brennan, 2013). Several aspects of these extruded products factors affecting, distribution etc. have been separated (Abbott, 1989, Alvarez-Martinez *et al.* 1988; Burnett and Peleg, 1972, Marper, 1981; Fazzolare, *et. al.* 1972).

The domestic market is a virgin territory in terms of branded prawn crackers, being manufactured

and marketed in India (Murthy and Thanuja, 2005). Demand for packaged food comes mainly from the urban sector in India. According to the industrial sources, almost 60% of their gross domestic product (GDP) can be attributed to India's urban population which makes up less than 30% of India's total population. Goa, coastal Gujarat, Bengal, Karnataka, Kerala and certain parts of northern India, Maharashtra are the major markets for prawn crackers (MPEDA, 2011). Internationally, European countries, America, Asian countries, Africa, etc. are few of the major global markets. (MPEDA, 2011)

But there is scanty of production of non-veg wafer. Keeping these points in view, study was undertaken to develop new product; prawns wafer by using different ingredients and using starch as the base material and formulations, and to optimize the process parameters so as to get the best product in terms of texture, colour and palatibility this paper describes the study carried out on this aspect.

Materials and Methods

The study was conducted at M/s Emperor Foods, Surat, India

Raw Materials

To conduct the study, the following raw materials were used:

Rice flour, Sabudana starch, Refined Wheat flour (Maida), Corn Starch, Prawns powder, Water, Rock salt, HVP, Liquid Oleoresin concentrate, Ammonium Bicarbonate, baking powder, sodium bicarbonate.Maida, or refined flour,a part of wheat flour (no germ or bran) Whiter, finer than wheat flour. Corn starch was used as a gelling agent,

Table 1: Details of the recipes used in the product- Non Veg wafers development

Ingredients (%)	Recipe 1	Recipe 2	Recipe 3	Recipe 4
Rice starch	38.50			
Water	22.00	32.00	21.6	20.73
Sago	13.00	11.11	28.00	
Potato starch	13.00	11.11		
prawns powder	10.00	7.00	8.11	7.48
Rock salt	1.00	1.11	1.74	
Salt	1.00	0.89		
Baking powder	1.00	1.00		
HVP	0.50	0.70	0.50	0.50
Rice flour		34.70	40.50	
Maida				58.00
Prawns slurry		0.40		
Oleoresin			0.12	0.18
Sodium Bicarbonate			0.08	
Corn starch				11.90
Sea salt				1.50
Ammonium bicarbonate				0.08

thickener or bulking agent Prawns and shrimps were used as a source of protein low in fat and calories (Ravichandran *et al.* 2009).

Hydrolysed vegetable protein (HVP) was used as a flavor enhancer. A naturally occurring mixture of oil and a resin extracted from various plants was used as a oleoresin. Being concentrated it was used in small quantity. Ammonium bicarbonate was used as a raising agent while palm oil was used to deep fry the product especially to increase the mouthfeel.

Recipes

Different recipes used in the experimental preparation of the product are shown in Table 1.

The process of prawn wafer making is shown in Fig. 1.

a.

b.

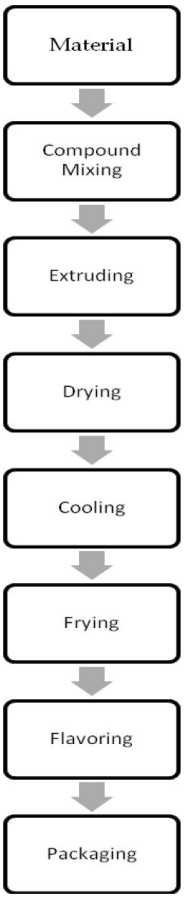

Fig. 1: Process flow chart of making non-veg extruded chips

a. Experimental Compound mixing

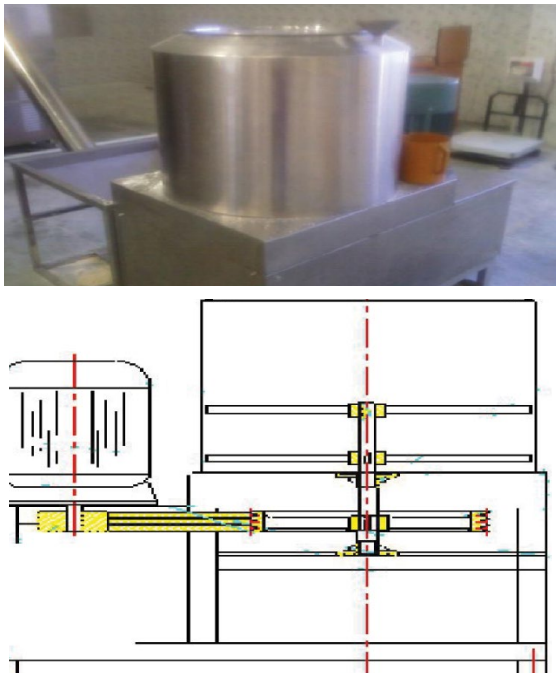

Fig. 2: Flour Mixer (i) Photograph, (ii) Line Diagram

Table 2: Specifications of Packaging Machine

Combination Volume:	Max. 3,000 cc
Combination Weight:	Max. 500 g
Display Increment:	0.1 g
Operation Speed:	Max. 70packs/min
Product Length:	Max. 80mm
Weigh Heads Number:	10
Weighing Method:	With Load Cell
Bucket Open/Close	With Stepper Motor
Program Number	Max. 50
Material contact with Product:	SUS 304
Power Requirements:	200/220/230/240acV+/- 50/60Hz, Single phase, 1.5kVA
Finish:	Painting on the surface not stainless steel with color of Munsell 5GY9/0.5

Environment: Temperature: Humidity: Vibration: Others:	-10 to 40 degree Celsius 35 to 85 % (no condensation) No power machine near the site. No direct sunshine, no high temperature devices such as a stove, no direct wind.
Physical: Dimensions: Weight:	950mm(W) * 950mm(L) * 900 to 1000mm(H) 260kg

Available options were: Gas flushing; Tear notch; Gusseted device; Air expeller; Hole punch device; Material stopper; Bag support and Polyethylene sealing system and Vacuum bag system.

A flour mixer (shown in Fig. 2) was used in mixing the raw and auxiliary material prepared, which were put into the mixer as per the required quantity. Dissolved liquid concentrate in water, mixed it well distributed and put into the mixer slowly until well distributed, operating slowly and agitating for about 5 minutes. Adjusted the amount of water added according to the moisture and working temperature. The coloring matter was added, dissolving in water. Then, was opened to the exit to let the material come out.

Table 3: Sensory scoring on balanced likert scale of 5 point

	Taste	Appe-arance	Texture	After taste	Mean	Standard Deviation
Recipe 1	3.2	3.9	4.5	2.8	3.6	0.75
Recipe 2	3.8	4.2	4.2	3	3.8	0.56
Recipe 3	4.2	4	4.8	4.2	4.3	0.34
Recipe 4	4.6	4.4	5	4.9	4.72	0.27

b. Extrusion

Advanced single screw extruder (Fig. 3) was used. It can give shapes like spiral, shell, peanut, ring, pipe, square pipe, wave, etc.

The main machine was allowed to heated to the fixed temperature, then started it and balanced the speed of feed, revolving and cutting. Specific condions requied for the product were set in the machine which were food for an example, the temperature was fixed were: 45-65°, 45-60°, 40-60°, 30-50°, 20-30°, the speed of the screw was 35-45 times every minute.

Fig. 3: Extruder

c. Drying: Dried the product under sunshine andturned over it continuously, put it into the dryer after the moisture was 14-16%, dried it in 50-60° for 3-5 hours that made the moisture fall to about 12%.

Cooling: Fried it after it cooled to the room temperature

e. Frying: Good quality of palm oil was used to fry the product for about 8 seconds in 200-220°; the was can be pulled out just as it floated on the pot. Get rid of oil by oscillating and bolting, put it into rolling flavor to be sprayed as seasoning and cooled.

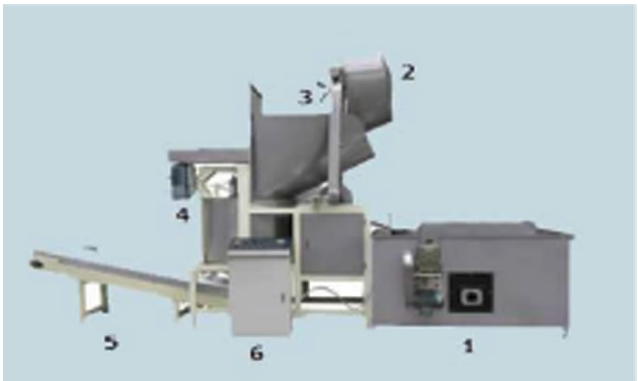

Fig. 4: Fryer. In the figuer, 1. Fryer, 2. Material Basket, 3. Rise and Fall Device, 4. Deoiling Machine, 5. Output Conveyor, 6. Controlling Panel

The automatic fryer (Fig 4) was having advanced technology, combining the need of actual manufacture. The machine is widely used for frying the extruded

pellets, such as shrimp chips, crispy rice, potato chips etc. and for frying the other similar products. It consists of a frying pan, frying sieve, deoiling system& discharging system, controlling system. Deoiling and discharging system used, consisted of: off centre roller, discharging part and hoister. After deoiling, the pull rod drive by cylinder made the cap on the bottom of the roller separate and then the material was dropped down on the belt of the conveyor and it went to the baskets which were prepared.

Table 4: Descriptive Analysis of the recipes based on the responses

	Response
Recipe 1	Product was found to have undesirable after taste, was sticky and color was also dark.
Recipe 2	The color was better but still there was undesirable aftertaste and the product was still sticky.
Recipe 3	Product was better in texture then previous trials and the after taste was also pleasant although, the product was stiff and not crisp as desired.
Recipe 4	The product obtained was bigger in size, fluffy, crisp and crunchy.

f. Flavoring

Fig. 5: Flavoring machine

Single roller flavoring line (Fig. 5) was used to finish spraying and then, seasoned the product by equally sprinkling the pulverized flavor.

g. Packaging

Fig. 6: Packaging Machine

An automatic packaging machine (Fig. 6) was employed for packaging the product. Packaging was done after the fried product was cooled. Packaging film was being first decided and then attached. Horizontal and vertical temperature for sealing was kept at 115°C. Further, the machine was run automatically or manually by setting the weight required, as the case was.

Its weigher was designed for weighing and packaging products having free flowing property. The specificants of packaging machine used are given Table 2 and packaged products (i) out side, (ii) other side is shown in Fig. 7.

Results and Disscussion

The results (Table 3 and 4) show that the product made by recipe no 1 was crispy and fluffy, aroma coming out of it was not so good as well as the after-taste and odor was also bad. It got stuck to the teeth after eating while the color obtained after frying was whitish brown. Overall appearance was average but, after taste and aroma of the product was not good and also had higher cost. It was found that this combination gave a harder and sticky product. As the extrusion temperature ideal for

rice flour is 180°C where other raw materials might have got burnt and also the color was wheatish due to the colour of prawns powder used which was unacceptable (Fennema, 1987).

Packaged Product Lable

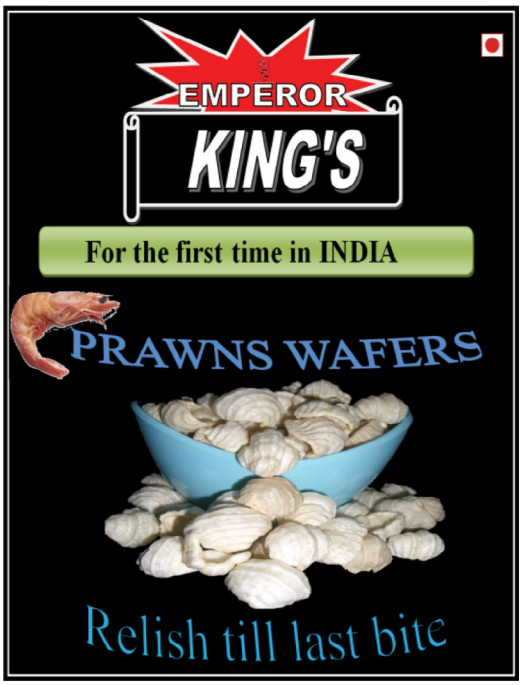

Fig. 7(i): Packaged product
(Coutesy of: Emperor Foods)

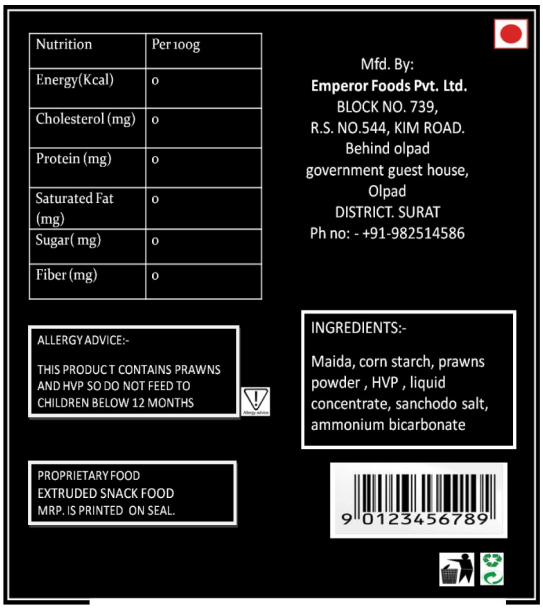

Fig. 7(ii): Sensory analysis
(Coutesy of: Khanna Family)

Sensory analysis was done according to the method given by Joshi (2006) on the 5 point balance likert scale, 5 meant excellent and 1 meant very poor for 10 panelists on various parameters were calculated.

In recipe 2, prawns powder was replaced by fresh prawns' juice as powder could be adulterated. So fresh prawns were brought and made juice out of it and also dried the fresh prawns and made powder out of it. The results (Table 3 and 4) showed that the earlier powder used was made from the lower quality of the prawns and the fish which had a bad odor.

We had used rice starch, sago starch, potato starch as the base material. Dehydrated prawns powder was used as the key ingredient in the recipe (Table 1) and further, additives like baking powder was added for leavening i.e. lightening the texture and increasing the volume (Fennema, 1987).

The product obtained from recipe no 2, was crispy and fluffy, its color was white, and the aroma of the product was good. Further after-taste of the product was there no doubt but the off-odor was not there, while it got stuck to the teeth.

Overall appearance of the product was very good. At the same time, juice based product was very costly, sticky and still had the bad after-taste. So, there was a need to develop the product which was economically feasible for the production and also to the consumer so need to change the formulation was felt and it was made it cost effective.

The product obtained from recipe no 2 was really good and well planned to sell out as our premium quality product. But the after-taste of the prawns after eating 10-15 chips bad odor.

In the third recipe, the same previous prawns powder was used as it was quite economical. Liquid concentrate was used as it overcame the bad odor and after-taste of the prawns powder. Use of salt was stopped as it didn't affect the taste of the product, while sodium bicarbonate showed better result than baking powder. Use of potato starch was discontinued as it didn't affect the product and was also costly.

In order to reduce stickyness, we replaced baking powder with sodium bicarbonate as it is more effective as leavening agent at higher temperatures. Also taste enhancer like HVP and some spice oleoresins were added to suppress the after taste of prawns. The result was (Table 3 and 4) better for taste but it was still somewhat sticky. As sodium bicarbonate is known to releases maximum carbon dioxide in presence of acids, which were missing in the recipe (Fennema, 1987). The product of recipe 3 was crispy, fluffy and the color was whitish brown. The after taste of the product was also good and odor was also good.The aroma coming out of it after frying was quite pleasant, overall appearance was quite good but still the product was sticky and costly.

Then, the rice flour was replaced with refined wheat flour in recipe 4, as it removed the stiffness of the product and so the product did not stick to the teeth. Corn starch was cost effective than Sago flour and it also gave good texture.

Ammonium bicarbonate gave 4 times higher fluffiness to the product than did sodium bicarbonate and sea salt along with taste also made the product crispy and fluffy. It was found that ammonium bicarbonate was a better leavening agent at higher temperatures than sodium bicarbonate. It gave almost 4 times more volume than sodium bicarbonate. (Fennema, 1987). The product obtain from recipe 4 was in line of the study established so far, it was much more crispy and fluffy, which was desirable. It had brownish white color. The product was having good after-taste and odor. It had quite pleasant aroma and didnt stick to the teeth. The product was also cost effective and feasible to the consumer and was much better in overall appearance and texture (Table 3 and 4).

Based on the results, it is apparent that the combination of Refined wheat flour (Maida) (58%), corn starch (11.9%), prawns powder (7.48%), water (20.73%), rock salt (1.5%), HVP (0.5%), Liquid oleoresin concentrate (0.18%), and ammonium bicarbonate (0.08%) gave the best result and thus, adjusted and as the best product.

Conclusion

The final product from recipe 4 was the standard product and it was also cost effective, very good in appearance, doesn't get stick to teeth, very crispy and fluffy, good in taste and aroma. Temperature of the extruder need to be maintained were 120-135°C in 2-4 areas and 65-70°C in 5th area. Optimum feeding speed was 30 rpm and of motor was 26 rpm. Cutting speed varied according to the need of the shape required. Optimum oven speed and temperature were about 30 rpm and 90-95°C respectively. For frying optimum temperature was 200-220°C for about 8-10 seconds.

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