

ISSUE NO 30

AUG '19

# ESSEN RIVESTA

*ENTWINE WORLD AND NUTRITION*

**EXTRUDED  
FOODS**



**ESSEN**  
RIVESTA

# Extruded foods

National news

International news

Cover story

Spot light

Social issues

Others

New product

Industrial updates

Who am I?

Farm to fork

Science data

Comics

Job opportunities

Book alert

Secrets that you don't know!!

AGRICULTURAL ENGINEERING COLLEGE AND RESEARCH INSTITUTE

TNAU, Coimbatore, Tamilnadu-641003

Cordially post your feedback to [eesenrivesta@gmail.com](mailto:eesenrivesta@gmail.com)

Don't forget to view our other publications at: [www.foodxploretnau.com](http://www.foodxploretnau.com)

PH.No : 9445110036, 9789743772



## NATIONAL NEWS

HEMA PRABA

### Britannia plans to give a salty twist to Time pass brand

Britannia industries, India's biggest biscuit maker, plans to enter the Rs 24,000 crore per annum salty snacks market, which is dominated by Haldiram's and PepsiCo. It plans to launch salty snacks under its existing brand Time pass by next month as part of a strategy to expand to non-biscuit segments. Britannia industries will compete mainly against PepsiCo and ITC that operate largely in western snacking segment such as potato chips, riblon and gathia, with brands such as kurkure and Bingo and extruded which include cheese balls.

### PepsiCo to spice up regional focus with papadam

PepsiCo being India's second largest snacks maker said it has taken inspiration from Hand-made and Hand-dried crunchy papad that is widely consumed with rice, rasam, dal or sambhar. The new extruded papad product under its lay's brand has been launched in Tamil Nadu, Karnataka, Andhra Pradesh and Kerala. PepsiCo attempt is seen as regionalization strategy.

### Growth of Extrusion snack Food Market in India

The Indian snack market is growing at 25% CAGR. The market in 2020 is estimated to be around Rs. 15000 crore as the market was 8000 crores in 2013. The Extruded snack market is positively influenced by growth of retail industry and it stood at \$600 billion in 2015 is projected to grow more than 8% in the coming years." Kids and young people are the primary buyers of Extruded snacks and they are also the target customer

## INTERNATIONAL NEWS

S. SAVITHA

### NoC.W. Brabender hires Kowalski as food extrusion specialist

C.W. Brabender (CWB) Instruments has hired Ryan Kowalski as food extrusion specialist for its food division. Kowalski will be primarily focusing on driving the application development of single-screw and twin-screw extrusion and interacting with customers to assist in the formulation process of their products. Kowalski will also be a hands-on contributor to discussions on product development in CWB's milling and baking products. Kowalski is a member of AACCI and IFT, has published 14 research papers on food extrusion and presented his research findings at several conferences. Kowalski has his BS in chemistry from Case Western Reserve University

and his PhD in food science from Washington State University. He has previously worked within the food industry for two years as both an applications and processing scientist with extruded food products and has spent time developing textured protein ingredients as well as protein crisps and rice crisps.

REFERENCE: <http://www.ift.org>

### Extruded Cereals Market In-Depth Market Research and Major Growth Report by 2029

Extruded cereals are the water or fat-based fillings in direct-expanded cereal envelope. Now a days, it is also possible to produce 3D shaped cereals with advanced technology.

There are various value-added ingredients available in the market for the extrusion of cereals, such as wheat flour, pre-gel corn flour, which allow flexibility of preparing to utilize their thickening characteristics. The consumption of whole grained extruded cereals is considered to have sustainable health benefits in deterrence from chronic diseases such as cancer, diabetes and cardiovascular diseases. Extruded cereals face the intense competition in the market with the introduction of new products in the industry and also the inclusion of new breakfast foods, both in food service and residential palaces. Baked ingredients are expected to gain high traction in the food industry, which is estimated to become a hindrance for the extruded cereals market.

REFERENCE: <http://www.dailychronicle24.com>

J.VIHASHINI

Extruded Inclusions Market Projected to Experience Major Revenue Boost during the period between 2018-2028 Extruded Inclusions in food processing industry is simply an operational process of shaping a dough like material by forcing it to pass through a restriction or die. The device used for performing such operation is referred to as food extruder which expedites the shaping and restructuring process for food ingredients. Extruders are widely used to cook, form mix, texturize and shape food products under favourable conditions that would favour quality retention, high productivity and low cost. New product developments and varied characteristic products are likely to be offered to fulfil the demand from customers for varied shapes, sizes in the end use dishes. The market for packed food products and processed food is likely to grow in the forecasted period owing to rising millennial demographics and hectic lifestyle patterns, which is likely to grow in turn the market for extruded food products in varied dishes worldwide

REFERENCE: <https://socioherald.com>

# IT'S MAGICAL EVEN IF YOU KNOW HOW IT IS DONE

S.M. SHANGAMITHRA, M. SOWRNARUBINI, B. NANDA

Extrusion is a process used to create products of a fixed cross-sectional profile. Food extrusion is a form of extrusion used in food processing. It is a high temperature short time (HTST) process. It is a process by which a set of mixed ingredients are forced through an opening in a perforated plate or die with a design specific to the food, and are then cut into a specific size by blades. The machine which forces the mix through the die is an extruder. The mix which is obtained is known as extrudate.

The extruder consists of a large, rotating screw which is fitted to a stationary barrel, at the end of which is the die.

Extrusion enables mass production of food by a continuous, efficient system that ensures uniformity of the final product. Food products manufactured using extrusion usually have a high starch content. These include some pasta, breads, many breakfast cereals and ready-to-eat snacks, confectionery, pre-made cookie dough, some baby foods, full-fat soy, textured vegetable protein, some beverages, and dry and semi-moist pet foods.

In the extrusion process, raw materials are first ground to the correct particle size, usually the consistency of coarse flour. The dry mix is passed through a pre-conditioner, in which other ingredients are added depending on the target product; these may be liquid sugar, fats, dyes, meats or water. Steam is injected to start the cooking process, and the preconditioned mix (extrudate) is then passed through an extruder. The extruder consists of a large, rotating screw tightly fitting within a stationary barrel, at the end of which is the die. The extruder's rotating screw forces the extrudate toward the die,

through which it then passes. The amount of time the extrudate is in the extruder is the **residence time**.

The extruded product usually puffs and changes texture as it is extruded because of the reduction of forces and release of moisture and heat. The extent to which it does so is known as the expansion ratio. The extrudate is cut to the desired length by blades at the output of the extruder, which rotate about the die openings at a specific speed. The product is then cooled and dried, becoming rigid while maintaining porosity. The cooking process takes place within the extruder where the product produces its own friction and heat due to the pressure generated (10–20 bar). The process can induce both protein denaturation and starch gelatinization under some conditions.

## Important factors of the extrusion process:

- the composition of the extrudate,
- screw length and rotating speed,
- barrel temperature and moisture,
- die shape and
- rotating speed of the blades.

Moisture is the most important of these factors, and affects the mix viscosity, acting to plasticize the extrudate. Increasing moisture will decrease viscosity, torque, and product temperature, and increase bulk density. This will also reduce the pressure at the die. Most extrusion processes for food processing maintain a moisture level below 40%, that is low to intermediate moisture. High-moisture extrusion is known as **wet extrusion**, but it was not used much before the introduction of twin-screw extruders (TSE), which have a more efficient

conveying capability. The amount of salt in the extrudate may determine the colour and texture of some extruded products. The expansion ratio and airiness of the product depend on the salt concentration in the extrudate, possibly as a result of a chemical reaction between the salt and the starches in the extrudate. Salt is also used to distribute minor ingredients, such as food colours and flavours, after extrusion; these are more evenly distributed over the product's surface after being mixed with salt.

### **HISTORY AND EFFECTS:**

The first extruder was designed to manufacture sausages in the 1870s. Packaged dry pasta and breakfast cereals have been produced via extrusion since the 1930s, the method was applied to pet food production since the 1950s (first extruded dog food in 1957 - Purina Dog Chow and first extruded cat food - Purina Friskies in 1962). It has also been incorporated in kitchen appliances, such as meat grinders, herb grinders, coffee grinders, and some types of pasta makers. A similar functional process occurs when pastry bags.

Extrusion has also enabled the production of new processed food products and "revolutionized many conventional snack manufacturing processes". The extrusion process results in chemical reactions that occur within the extruder barrel and at the die. Extrusion has the following effects:

- Destruction of certain naturally occurring toxins
- Reduction of microorganisms in the final product
- Slight increase of iron-bioavailability
- Creation of insulin-desensitizing starches (a potential risk-factor for developing diabetes)

- Loss of lysine, an essential amino acid necessary for developmental growth and nitrogen management
- Simplification of complex starches, increasing rates of tooth decay
- Increase of glycemic index of the processed food, as the "extrusion process significantly increased the availability of carbohydrates for digestion"
- Destruction of Vitamin A (beta-carotene)
- Denaturation of proteins.

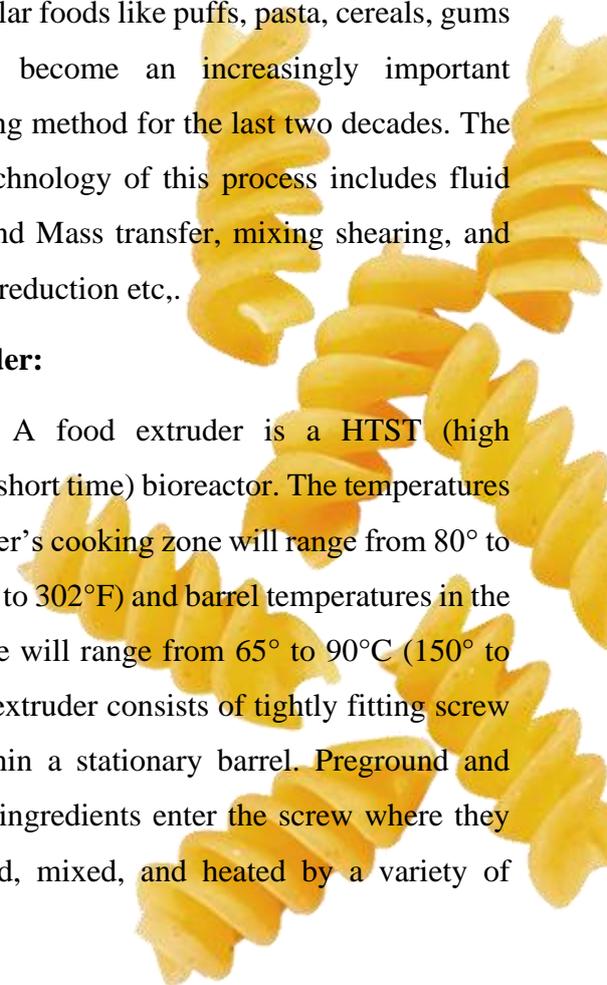
High-temperature extrusion for a short duration "minimizes losses in vitamins and amino acids". Extrusion enables mass production of some food, and will "denature antinutritional factors", such as destroying toxins or killing microorganisms. It may also improve "protein quality and digestibility", and affects the product's shape, texture, colour, and flavour.

### **Process:**

The snack industry is the fastest growing food sector and is the king in producing convenience foods. Extrusion plays a major role in producing such kind of popular foods like puffs, pasta, cereals, gums etc....It has become an increasingly important manufacturing method for the last two decades. The advanced technology of this process includes fluid flow, heat and Mass transfer, mixing shearing, and particle size reduction etc.,

### **Food extruder:**

A food extruder is a HTST (high temperature short time) bioreactor. The temperatures in the extruder's cooking zone will range from 80° to 150°C (175° to 302°F) and barrel temperatures in the forming zone will range from 65° to 90°C (150° to 194°F). An extruder consists of tightly fitting screw rotating within a stationary barrel. Preground and conditioned ingredients enter the screw where they are conveyed, mixed, and heated by a variety of



processes. The product exits the extruder through a die where it usually puffs and changes texture from the release of steam. The common process of any extruder will be

All the dry ingredients, along with liquid ingredients such as an emulsifier, lipids, and moisture (water), are loaded in measured amounts to the blender and mixed for the required time. Variable speed feeder is usually in the form of an inclined screw conveyor, rotated by a geared motor, which transfers the pre blended raw-materials from the blender to

the extruder hopper. The extruder has hopper along with a horizontal auger screw run by a variable speed. The volumetric feeder constantly supplies a preset amount of raw-materials into the extruder inlet and over the extrusion screw running inside electrically heated barrel. These materials are continuously moved. The product temperature at the die exit can be as high as 190°C. A coating unit is used to spray oil on an expanded product and to dust product with suitable seasoning such as salt additional mouth feels and crunch.

### **EXTRUDED PRODUCTS:**

**Types of Extrusion System:** The use of thermoplastic extrusion in food processing is facilitated by the vigorous activity and process of extruders, which can be divided into two types: single-screw and twin-screw extruders. A variety of extruders with different configurations and performances have been developed and they are categorized based on their applications, design and configurations. Extruders are composed of five main parts:

1. the pre-conditioning system.
2. the feeding system.
3. the screw or worm.

4. the barrel.
5. the die and the cutting mechanism.

They can vary with respect to screw, barrel and die configuration. The selection of each of these items will depend on the raw material used and the final product desired. The food (melt) is fed at one end of a tubular structure housing the screw. Inside this housing the melt is worked upon to form a semi solid mass. The semi-solid mass is forced through a restricted opening (die) at discharge end of the screw. The food comes out expands as it touches the atmosphere. This expansion is because of the bubble growth in the semi-solid mass because of the moisture that it contains. The expanded product is the extrudates can be consumed as it is, or after desirous processing. Single-screw extruders are the most common extruders applied in the food industry. The classification of single-screw extruders can be defined based on process or equipment parameters such as:

- ❖ Moisture content (dry or wet) conditioning
- ❖ Solid or segmented screw
- ❖ Desired degree of shear and heat source.

From a practical point of view, the main classification used considers the degree of shear and the heat source. The screw configuration comprises there are screws made up of only one piece or screws of multiple pieces. Twin-screw extruders are composed of two axis that rotate inside a single barrel, usually the internal surface of the barrel of twin-screw extruders is smooth. Depending on the position of the screws and their direction of rotation, four different types of configurations are possible:

- i. co-rotating intermeshing screws.
- ii. co-rotating non-intermeshing screws.
- iii. counter-rotating intermeshing screws

#### iv. counter-rotating non-intermeshing screw

Although intermeshing screws result in greater residence time of the material in the extruder, non-intermeshing screws cause greater degrees of shear, especially if they rotate in opposite directions. However, twin screw type of extruder is little used in the food industry, even though they present more efficient displacement properties.

### EXTRUDER VARIABLES

Screw speed, barrel temperature, screw and barrel configuration, die opening and feed rate are some of the parameters that affect the extruded performance. Extruder operation depends on pressure build up in the barrel (prior to exiting the die), slip at the barrel wall (transportation), and the degree of filling. The screw speed is responsible for the rate of shear development and the mean residence time of the feed. The heat dissipation from the mechanical energy input to dough depends on screw speed, which in turn influences dough viscosity. The feed zone temperature must be low to avoid plugging and back flow of material travel down the screw. The barrel temperature has positive effect on the degree of starch gelatinisation and extruded expansion whereas it has a negative effect on product colour especially at elevated temperature. Several studies have indicated that elevated temperature leads to more moisture evaporation when exiting the die and thus results in more expanded products. Extruder feed rate depends on the types of screw element, screw speed, type of feeding element and feed moisture. The feed rate has an influence on residence time, torque requirement, barrel pressure and dough temperature.

### FEED INGREDIENT VARIABLE

Feed composition, moisture content and particle size have the greatest effect on extrusion. The typical composition of any blend consists of starch, protein, -lipid/fat and fiber which contribute the product quality. The starch degradation usually reduces products expansion. The infant and weaning foods have high starch digestibility which is largely dependent on full gelatinisation. The lipid levels over 5- 6% acts as a lubricant, reducing the slip within the barrel and resulting in poor product expansion. The fibres are the non interacting component that contributes to low expansion, cohesiveness, durability and water stability. Higher fiber content usually results in high screw wear. The moisture is critical variable that has multiple fractions in starch gelatinization, protein denaturation, barrel lubrication and the final product quality. A dry extruder can process materials with 8- 22% moisture with no additional drying of extrudates. Most extrudates snacks have moisture content between 8- 12% and require additional drying to impart desired texture and mouthfeel. General rule of thumb that the extruder feed should not have particles larger than one third the diameter of die holes. Particle size also plays an important role in moisture distribution, heat transfer, viscosity and final product. Quality coarse ingredient particles have more effect on wear than fine particles. A product composed of fine particles will have good water stability, water absorption index, expansion.

### SOURCES OF RAW MATERIALS IN EXTRUSION COOKING:

The most used raw materials in the extrusion process are starch and protein-based materials. This technique has been widely used with raw materials such as corn, wheat, rice and soybean.

Natural biopolymers of raw materials such as cereals or tuber flours are rich in starch, or oilseed legumes and other protein rich sources. Most commonly used materials are wheat and corn flours, but many other materials are also used such as rice flour, potato, rye, barley, oats, sorghum, cassava, tapioca, buckwheat and pea flour. The protein rich materials such as pressed oilseed cake from soya, sunflower, rape, field bean, fava beans or separated proteins from cereals such as wheat (glutens). Expanded (Ready to Eat) RTE cereals are manufactured from mixtures of cereal flours and starches combined with small amounts of malt, fat, sugars, emulsifiers, and salt. The structure of the extruded products may be formed from starch or protein polymers. Most products, such as breakfast cereals, snacks and biscuits are formed from starch, while protein is used to produce products that have meat-like characteristics and that are used either as full or partial replacements for meat in ready meals, dried foods and many pet food products.

### ROLE OF STARCH IN EXTRUSION COOKING

Extrusion cooking processes cover various combinations of ingredients including: cereals, grains and starches, tubers, legumes, oil seeds, cereals as well as animal fat and proteins. Most raw materials used in food extrusion are solid. The structure of the extruded products may be formed from starch or protein polymers. Further, ready to eat breakfast was successfully developed using the low amylose rice flour incorporated with seeded banana powder in a single-screw extruder. Native starch undergoes substantial changes leading to greater molecular disorganization during extrusion cooking. Most importantly from the perspective of finished product texture, the starch loses its relative

crystallinity, undergoes molecular fragmentation, and often complexes with lipids in the feed texture. The role of shear, temperature, moisture and feed composition are significant in the transformation of starch by extrusion. The starch granule consists of two different glucose polymers: amylose and amylopectin, which are responsible for its physicochemical and functional properties. Inside the extruder, starch undergoes several stages. First, the initial moisture content is very important to define the desired product type. Inside the extruder have relatively high temperatures, the starch granules melt and become soft, besides changing their structure that is compressed to a flattened form. The application of heat, the action of shear on the starch granule and water content destroy the organized molecular structure, also resulting in molecular hydrolysis of the material. The final expanded product presents air cells that are formed due to superheated water vapor pressure. When the temperature of the extrudate is reduced below its glass transition temperature, it solidifies and maintains its expanded form. As dough's temperature exceeds the transition threshold temperature, the starch molecules begin to undergo various disordering reactions that affect their size and shape. Since rheological properties are related to the size and shape of a fluid's molecules. It seems logical to assume that these molecular changes within starch will greatly affect their rheological properties

### **Snack foods:**

Consumer acceptance of extruded foods is mainly due to the convenience, value, attractive appearance, and texture found to be particular for these foods, especially when it concerns to snack products. Snack

food extrusion includes subjecting selected grains to a variety of complex physical processes to yield snacks with varied shapes and textures. Novel ingredients, cutting-edge extrusion technology, and innovative processing methods are combined to yield new snack products with ever widening appeal to health-conscious consumers that are seeking different textures and mouth feeling with convenience. In addition, several extrusion processing conditions are accounted for the quality of finished products. The success or failure of a new extruded snack food product is directly related to sensory attributes, where texture plays a major role. In such foods, where expansion is desired and puffed products are expected, texture is of major importance, with crispness being one of the most important attributed. Extruded flours from fresh and hardened chickpea was prepared and lead to higher values of total colour difference, water absorption index, dispersible and lower Hunter L value, particle size index, and water solubility index than conventional flours. Sweet whey solids (SWS) or whey protein concentrate (WPC) were added at concentrations of 250 and 500 g/kg to corn meal, rice, or potato flour to make snack products.

Current development and trends of the snack industry

1. Multidimensional snack food production
2. Use of super/subcritical fluids in snack food production
3. New applicator/dryers for low- or no-fat applications
4. New health benefits for extruded snack foods

Multidimensional snack products as of the third-generation products are not new to the industry. They

have been popularly used in many regions of the world. Extrusion system in this process is efficient and economic which is built in a marketing flexibility. The supercritical fluid injection with CO<sub>2</sub> to expand the product (puffed) has already resulted in a new development of cereals, confectioneries, pastas, flavourings, pharmaceuticals, snacks etc. Product expansion by CO<sub>2</sub> offers several advantages as compared to steam expansion in the extrusion process as

- ❖ a closed cell structures.
- ❖ the product's interior is very nearly oxygen free.

An applicator or dryer is usually an integral component for an extruder which is originally designed for sugar coating and frosting. It has been taken as a superior method of coating snack products with colours and flavours. Initial studies show that extruded products have improved cholesterol-lowering effects over baked products.

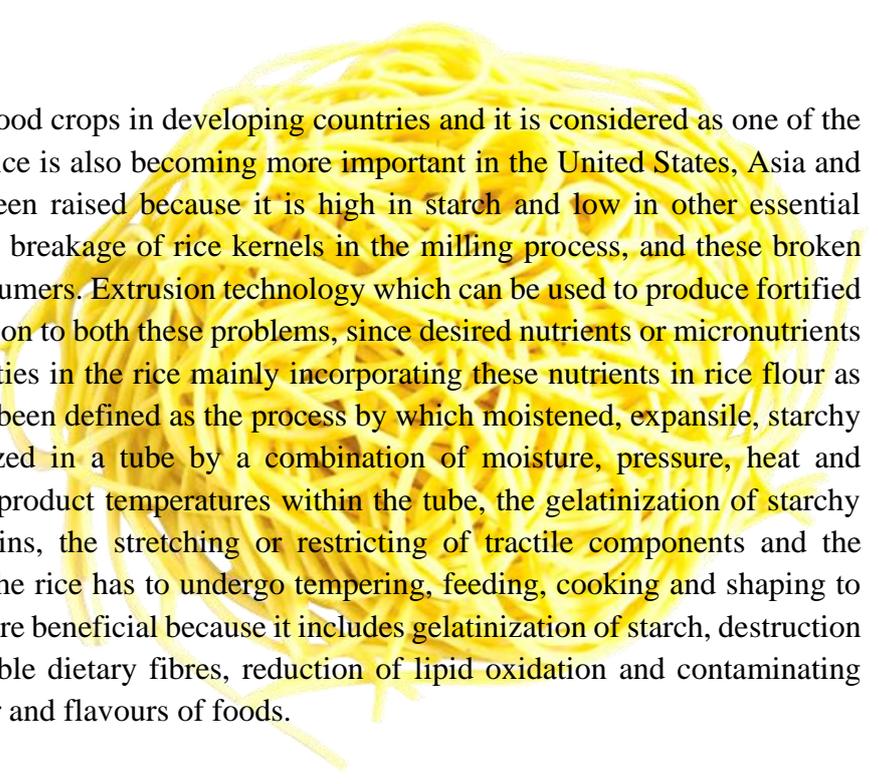
### **Global trends:**

In this fast-moving world people often prefer ready to eat food than prepared proper food diet. According to IMARC, the leading Group of research market, the global extruded snack food market reached a value of around US\$ 80.6 Billion in 2018, growing at a CAGR of around 3% during 2011-2018. IMARC Group's latest study, titled, "Extruded Snack Food Market – based on Global Industry Trends, Share, Size, Growth, Opportunity and Forecast 2019-2024"

**REFERENCE:** <https://www.ncbi.nlm.nih.gov/>  
<https://www.mdpi.com/> [www.researchgate.net](http://www.researchgate.net/)

## **EXTRUDED PRODUCTS**

VENTHARISH RAJ G K

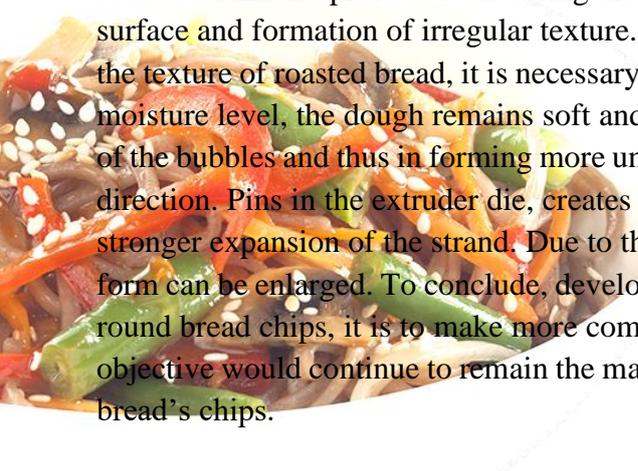


Today, rice is one of the most important food crops in developing countries and it is considered as one of the staple food in many parts of the world. Rice is also becoming more important in the United States, Asia and Middle East. However, concerns have been raised because it is high in starch and low in other essential nutrients. Another issue of concern is the breakage of rice kernels in the milling process, and these broken kernels are not generally accepted by consumers. Extrusion technology which can be used to produce fortified rice, or rice analogues, can present a solution to both these problems, since desired nutrients or micronutrients can be incorporated in appropriate quantities in the rice mainly incorporating these nutrients in rice flour as the base material. Extrusion cooking has been defined as the process by which moistened, expansile, starchy and proteinaceous materials are plasticized in a tube by a combination of moisture, pressure, heat and mechanical shear. This leads to elevated product temperatures within the tube, the gelatinization of starchy components, the denaturation of proteins, the stretching or restricting of tractile components and the exothermic expansion of the extrudate. The rice has to undergo tempering, feeding, cooking and shaping to become extruded. The extruded products are beneficial because it includes gelatinization of starch, destruction of anti-nutritional factors, increased soluble dietary fibres, reduction of lipid oxidation and contaminating microorganisms and retains natural colour and flavours of foods.

**REFERENCE:** [www.newfoodmagazine.com](http://www.newfoodmagazine.com)

## **EXTRUDED BREAD CHIPS**

K. MADHUBALA



In contrast to other direct extruded products, which are cut at the die-face, extruded bread chips are cut only after the expanded dough has cooled to some extent and has become firm. This cut, made through an already expanded material, creates an open pored extrudate surface with an attractive optical appearance and texture. In order to expand the overheated dough at the exit of the die into a well-formed strand, the dough in the die must be held under a definite pressure which is larger than the steam pressure. The dough temperatures of 160-180-degree Centigrade demand a minimum pressure of 6 – 10 Bar. Selecting a big die opening to achieve a strand with the largest cross section, causes a lower die-pressure. The result is a badly formed, splitting strand, with a rough surface. The capacity of an extruder can be reduced up to 40% of the rated capacity, required to maintain the minimum necessary die-pressure in the production of bread-chips. One can increase the die pressure through a higher viscosity of the dough (lower moisture) and thus cause a higher expansion. Dough with lower moisture hardens very quickly and is hence subjected to very little shrinkage, which is an advantage. A lower moisture however also encourages the formation of very soft textures, which differentiates from the texture of "roasted bread". Highly viscous, dry dough have lower elasticity, as a result, tension is caused within the product even during the process of expansion. These tensions lead to splitting of the strand surface and formation of irregular texture. In order to obtain a crunchy and uniform texture, which resembles the texture of roasted bread, it is necessary to carry out the extrusion at high moisture levels (17-20%). At this moisture level, the dough remains soft and elastic. The use of full-grain raw-materials help to reduce the size of the bubbles and thus in forming more uniform textures. But they also reduce the expansion in the transverse direction. Pins in the extruder die, creates spaces within the strand to a higher die pressure and hence cause a stronger expansion of the strand. Due to the formation of the empty spaces within the product, the size of the form can be enlarged. To conclude, development trends for bread chips is increasing. In addition to the simple round bread chips, it is to make more complex forms with open pores using this cutting technique. The main objective would continue to remain the maximization of the product size, i.e. the surface size of the individual bread's chips.

**REFERENCE:**<http://www.foodextrusion.de>.

## BREAKFAST CEREALS

**Rithanya S**

Cereals are generally of the gramineous family and, in the FAO concept, refer to crops harvested for dry grain only. Cereals are grown for their highly nutritious edible seeds which are often referred to as grains. They supply a variety of nutrients and other food components like phytochemicals or plant bioactive substances, which may have health-promoting effects. Cereal food has a relatively low energy density, and foods rich in wholegrain cereals may help reduce hunger as they are relatively bulky. Most cereals contain a large amount of starch

In natural form, the starch is insoluble, tasteless and unsuited for human consumption. To make it digestible and acceptable, cereals are processed using different methods to develop several cereal products that are consumed on a daily basis. In the United States, the word 'cereal' is typically synonymous with a processed product that is suitable for human consumption with or without further cooking at home and is usually eaten at breakfast. Ready-to-eat cereals are typically grouped by cereal form rather than the type of grain used. These groups are flaked cereals, extruded flaked cereals, gun-puffed whole grains, extruded gun-puffed cereals, oven-puffed cereals, shredded whole grains, extruded shredded cereals, and granola cereals. One of the most important methods used widely in the world to process the cereals is the extrusion cooking process. Breakfast cereal products were originally sold as milled grains of wheat and oats that required further cooking in the home prior to consumption. In this century, due to efforts to reduce the amount of in-home preparation time, breakfast cereal technology has evolved from the simple procedure of milling grains for cereal products that require cooking to the manufacturing of highly sophisticated ready-to-eat products that are convenient and quickly prepared.

The most commonly used cereals are corn, oats, farina cereals, wheat, rice and barley. The fortified RTE breakfast cereals were associated with higher daily intakes of most micronutrients and fiber, and with a macronutrient profile consistent with current nutritional recommendations. The extruded cereals supply the human diet with riboflavin, niacin, folate and vitamin B<sub>12</sub>. The breakfast cereals may help maintain mental performance over the morning compared to no breakfast or a glucose drink. A small study in adults also found that a higher-fiber carbohydrate rich breakfast was associated with the highest post-breakfast alertness rating and the greatest alertness between breakfast and lunch. A larger study found an association between breakfast cereal consumption and subjective reports of health, with those adults who ate breakfast cereal every day reporting better mental and physical health, compared to those who consumed it less frequently. Cereals also play an important role in the heart health by lowering the rates of CHD and strokes. Extrusion cooking is now a well-established process for producing cereal based products. This process can be used to make many food products from cereal besides breakfast cereal and snacks, such as flat bread, soup bases, modified starches, brewing adjunct, etc.,. Cereals have been a mainstay of the diets of people worldwide. It is now recognized that cereals can also provide other bioactive substances, which may prove important for health. To increase consumption of wholegrain foods, it may be useful to have a quantitative recommendation. Additionally, a wider range of wholegrain foods that are quick and easy to prepare would help people increase their consumption of wholegrain foods.

**Reference:** <https://www.britannic>



# The Global Extruded Food Market.

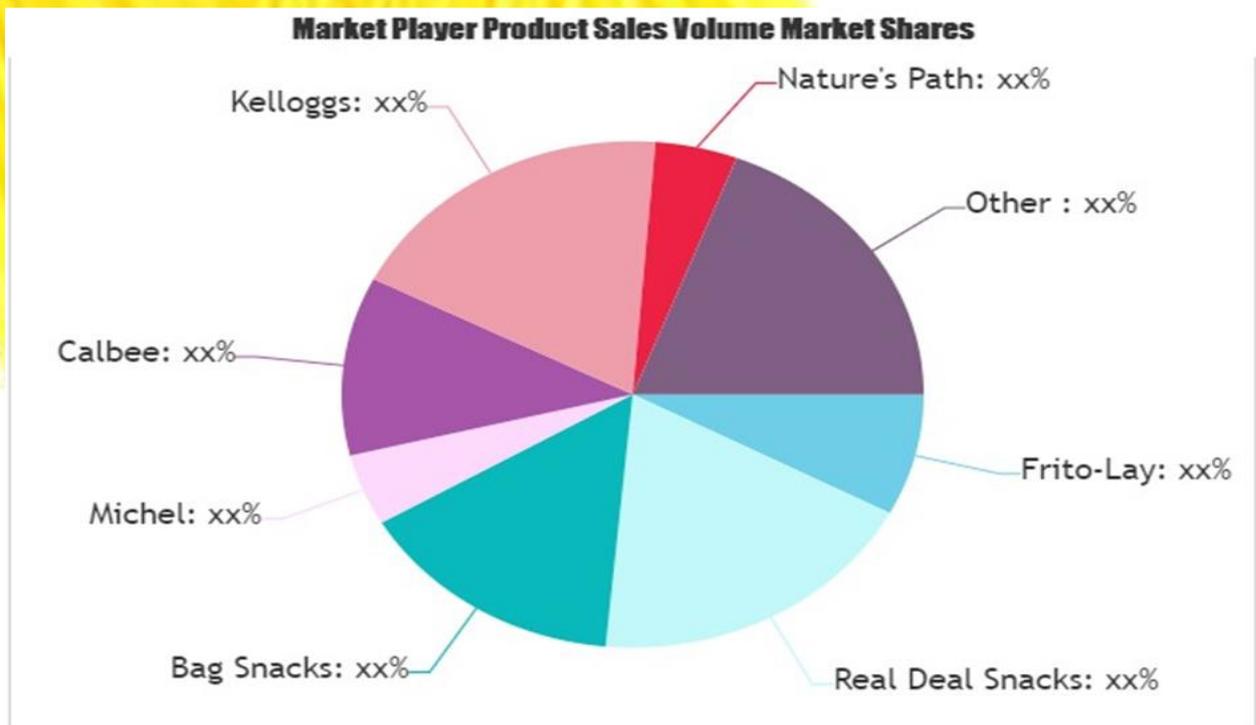
**Kiran J**

It has been noticed that there is a continuous growth in the market of extruded foods. It is also expected that in the further period of 2019-2025 there will be

due to different shapes, size, color. tremendous growth. Since extruded foods have different roles as breakfast cereals, snacks, and other food ingredients and also it is rich in starch all this character makes demand for the extruded products globally.

Extruded foods as gained more popularity among the teenagers Companies are following the lifestyle changes provides with the same what is needed to the present generation and culture and hence, they stand unique. Also, the companies need to focus on the nutritional quality of the extruded foods since it may affect the health of the consumers.

Extruded products have been segmented into different categories based on the types, raw material and the end user. It is classified into hot extrusion food processing and cold extrusion food processing based on types. And it is segmented as cereal, corn, mixed grains and others. Based on the end user it is classified as pet food products and food products.



## IS IT HEALTHY?!

SHALINI S

Extrusion technology is used to produce a wide range of products in food industries - formed products like noodles, pasta and snack pellets; cooked but dense products like pet foods and some aqua feeds, expanded products like breakfast cereals, texturized products such as TVP (Texturized Vegetable Protein) and meal analogues. Extrusion processing and products offers number of major benefits over traditional processes but also have limitations such as:

- Creation of insulin - desensitizing starches (a potential risk factor for developing diabetes).
- Loss of lysine, an essential amino acid necessary for growth and nitrogen management.
- Simplification of complex starches, increasing rates of tooth decay.
- Increase of glycemic value.
- Destruction of Vitamin A (Beta – carotene).
- Denaturation of protein.
- Vitamins with heat liability are destroyed.
- Maillard reactions reduces nutritive value of proteins.

## PHYSICOCHEMICAL CHANGES DURING EXTRUSION

### 1. Changes in starch

- i. At relatively high temperature, the starch granules melt and become compressed to a flattened form.
- ii. Heat and the action of shear destroy the organized molecular structure, also resulting in molecular hydrolysis of the material.
- iii. Dispersed and degraded to form a continuous fluid melt.
- iv. The starch polymer becomes glassy as moisture is removed, forming a hard-brittle texture.

### 2. Change in protein

- i. Proteins are more reactive and undergo many changes during the extrusion process, most important being denaturation.
- ii. During extrusion, disulfide bonds are broken and may reform.
- iii. High molecular weight proteins can dissociate into smaller subunits.
- iv. Enzymes lose their activity after being submitted to high temperature and shear.

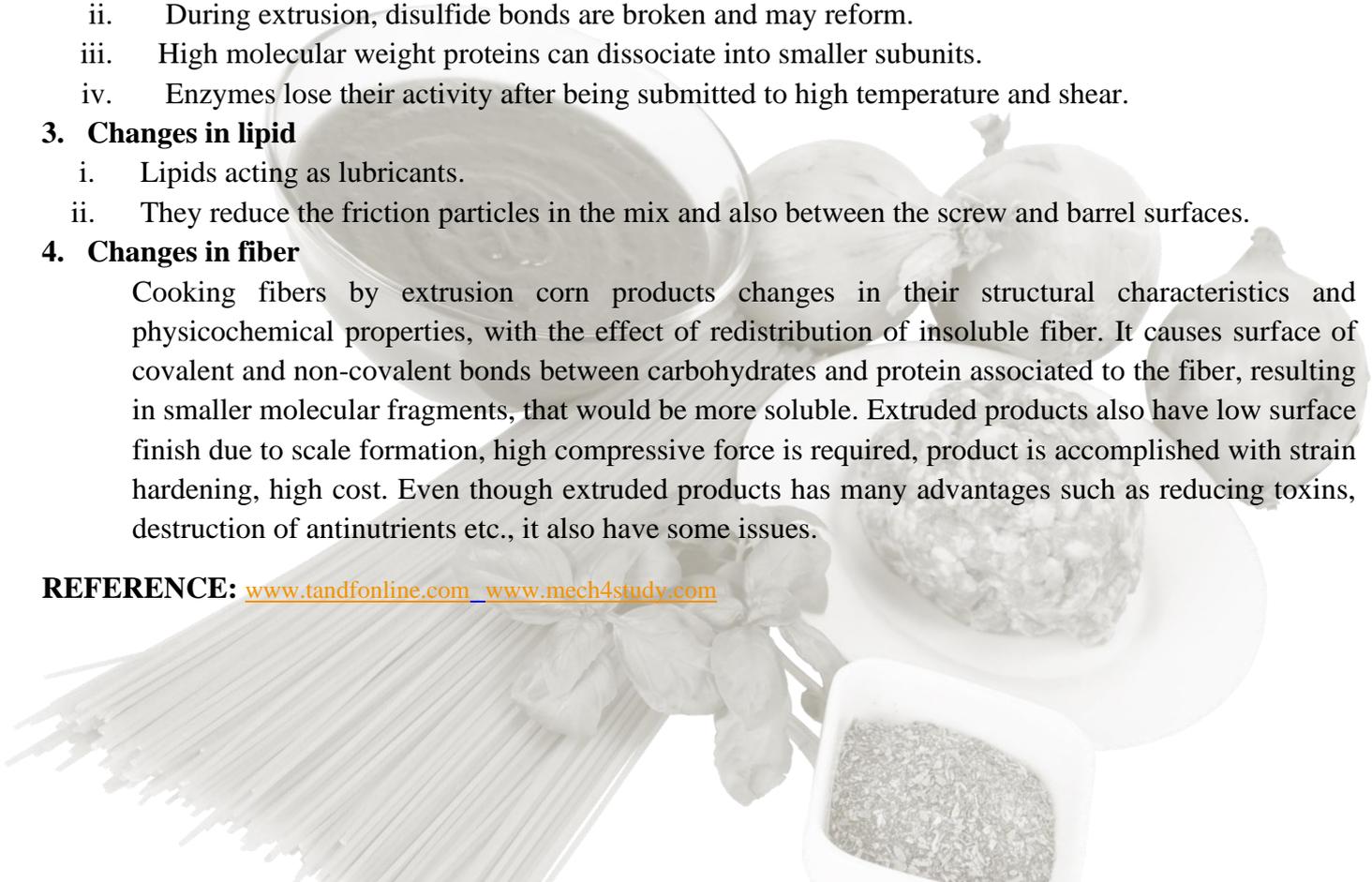
### 3. Changes in lipid

- i. Lipids acting as lubricants.
- ii. They reduce the friction particles in the mix and also between the screw and barrel surfaces.

### 4. Changes in fiber

Cooking fibers by extrusion corn products changes in their structural characteristics and physicochemical properties, with the effect of redistribution of insoluble fiber. It causes surface of covalent and non-covalent bonds between carbohydrates and protein associated to the fiber, resulting in smaller molecular fragments, that would be more soluble. Extruded products also have low surface finish due to scale formation, high compressive force is required, product is accomplished with strain hardening, high cost. Even though extruded products has many advantages such as reducing toxins, destruction of antinutrients etc., it also have some issues.

**REFERENCE:** [www.tandfonline.com](http://www.tandfonline.com) [www.mech4study.com](http://www.mech4study.com)



# YOGHURT

SHANMUGADEVI.M

Yogurt is a food produced by bacterial fermentation of milk. The bacteria used for the fermentation are known as yogurt culture. Yogurt is also spelled as yoghurt, yoghurt. Cow milk is commonly used to make yogurt. Milk from water buffalo, goats, camels are also used to produce yoghurt. The milk used may be homogenized or not, even pasteurized or raw.

In the ancient Indian records, the combination of yogurt and honey is called “the food of the gods”. In 2017 the average American ate 13.7 pounds of yogurt. Sale of Yogurt was down 3.4 % over the 12 months ending in February 2019.

Yogurt which is plain (unsweetened) produced from whole milk have the following nutritional value

❖ Energy	406 k
❖ Sugar	4.0 g
❖ Fat	5.0 g
❖ Protein	9.0 g
❖ Vitamins (A, B, C)	0-0.3mg
❖ Minerals	0-100mg
❖ Water	81.3 g

Yogurt (Plain yogurt from whole milk) is 81% water ,9% Protein ,5% fat, 4% carbohydrate including 4% sugar. As the portion of the daily value (DV) a serving of yogurt is a rich source of vitamin B12 and riboflavin with moderate content of protein and phosphorus. The energy and fat content are high in milk when compare to milk. Yogurt often associated with Probiotics, which have been postulated as having positive effects on immune, cardiovascular or metabolic health.

## What is the difference between Yogurt and curd?

Curd or Dahi is a dairy product made by curdling of milk with edible acidic substance such as lemon juice or vinegar whereas Yogurt is created by bacterial fermentation of milk by using Yogurt culture that consist of *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. **Varieties of Yogurt:** FDA (Food and Drug Administration) established some of the varieties and their definitions they are:

To produce yogurt, milk is first heated, usually to about 85°C, to denature the milk protein so that they do not form curds. After heating the milk is allowed to cool about 45°C. The bacterial culture is mixed and maintained for 4 to 12 hours to allow fermentation to occur.

- **Low fat and Nonfat:** Made from low fat milk and skim milk. Fat content is between 2 and 0.5.
- **Lite yoghurt:** 50% reduction in regular yogurt
- **Swiss or Custard:** Fruit and yogurt are mixed together for individual servings. This is also known as ‘blended’ yogurt.
- **Frozen Yogurt:** It is a refrigerated Yogurt product.
- **Sundae or Fruit-on-the-bottom:** Fruits is on the bottom, so that turned upside down, it looks like sundae.

## Benefits:

Yogurt provides protein and calcium, and it may enhance healthy gut bacteria. Health benefits range from protecting against osteoporosis to relieving irritable bowel disease and aiding digestion, but these depend on the type of yogurt consumed. Added sugar and some processing can make some yogurt products unhealthy.

Try topping Greek yogurt with berries or chopped fruits to increase your meal’s vitamin, mineral and fiber content. Summary Greek yogurt is high in protein, helps to reduce appetite and may aid weight loss.

## Disadvantage:

Whole milk and flavored yogurts can pose a disadvantage for people who are dieting or watching their blood-sugar intake. An 8-ounce portion of low fat, fruit -flavored yogurt contains approximately 42 grams sugar whereas in unflavored 16 grams. approximately 7 grams in plain Greek yogurt.



## Lil Bites

S.M.K KARTHICK RAJ

Arun Icecreams is a well known brand of Hatsun Agro products Ltd. Due to the increasing demands of the youth and young to Eat different colour, texture, shape, flavour, aroma and size , Arun Icecreams have released new varieties of Icecreams. The Fact about them is they are Extruded Icecreams. Most of the Bar Icecreams are also extruded Icecreams.

### Little Bites :

Little bites Cotton Candy

Little bites Cream Cookie

Little Bites Lychee

Little Choco-Toffee



All of these Tasty Yummy Extruded Lil-bite Icecreams are available in 15ml packs for 5Rs. All it Takes is One Bite to experience a Little bit of Indulgence.



### Nutri-Bites:

Nutri-Bites are Produced by Cereal Ingredients Inc. They are Ingredient Manufactures they formulate ingredients specifically for specific Clients. Nutri-Crisps products consist of direct expanded pieces with special nutritional qualities such as extra levels of protein, fiber, vitamins and minerals. Our Nutri-Crisps are available using pea, rice, sorghum, soy, quinoa, ancient grains, and a variety of other pulse grain protein sources.

Nutri-Crisps are available in a variety of protein content and sizes. Protein content of Nutri-Crisps is 25-80 percent and additional pulse grains available as well. The products can vary in shape, bulk density and flavour based on customer preference.

### Applications:

Nutri-Crisps can be used in the following applications:

- ❖ Nutritional and Cereal Bars
- ❖ Panning centre for coated snacks or eaten as is as a snack
- ❖ Granola and Snack Mix Inclusions
- ❖ Healthy Crunch topping or tack-on for coated snacks, bars and pretzels



Reference: <https://www.snackandbakery.com/articles/87631-nutri-bites-whole-grain-soy>



## INDUSTRIAL UPDATES:

### V.MONICA

Global companies such as bag snacks, inter snack group and Lengdor operate at global and regional level. These companies show development in the field of extruded snacks products. Some of the extruded product producing companies are PEPSICO, KELLOG'S, FRITO LAY, NDFM FOODS LTD ETC.



### FRITO LAY:

PepsiCo was formed by the merger of Frito Lay. Frito Lay North America produced more than 16 billion bags of snacks across its brands, Cheetos, Fritos, Doritos, Lays, ruffle.

### NESTLE INDIA:

Nestle India was first set up at MOGA in 1961. In 2018, Nestle India had a revenue of Rs11, 292.27 crore. The FMCG has planned to invest Rs700 crore to manufacture instant noodles Maggi.

### KELLOGG'S:

Kellogg's has witnessed a 51% stake in the Delhi with Haldiram's valuing Rs 20,000crore (USD3Billion). Kellogg's is the second largest snack food company.

### HALDIRAM'S:

Haldiram's snacks and Ethnic food is the largest group with revenue of Rs 2,619 crore till 31March2019.

### DFM FOOD LTD:

The company sells salty snacks such as CRAX CORN RINGS that alone contributes half the to the total sales. DFM FOODS LTD show up an offer for 26%of share capital of company at Rs249.50/share.

### PEPSICO:

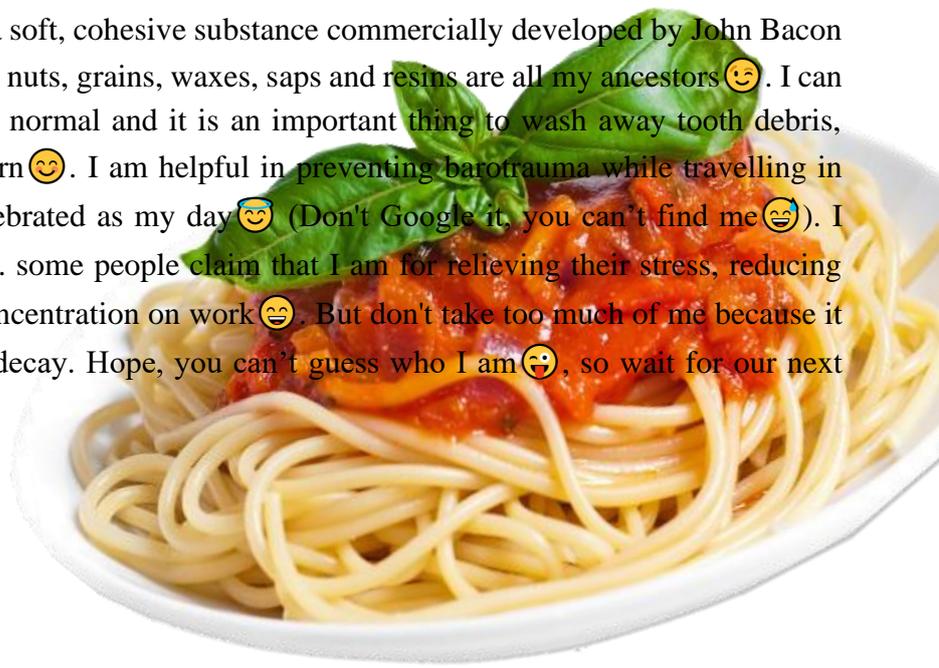
PepsiCo has Rs 514 crore investment to double the sales in the world's second most populous country.

**REFERENCE:** <https://www.clextral.com/food-feed-2/food/> <https://economictimes.indiatimes.com>

## WHO AM I?

### M.HALILUR RAHMAN

Hi, I am an extruded product. I am a soft, cohesive substance commercially developed by John Bacon Curtis in 1848. Sweet grasses, leaves, roots, nuts, grains, waxes, saps and resins are all my ancestors 😊. I can make you produce 250% more saliva than normal and it is an important thing to wash away tooth debris, removing bad breath and reducing heartburn 😊. I am helpful in preventing barotrauma while travelling in airplanes 😊. 30<sup>th</sup> day of September is celebrated as my day 😊 (Don't Google it, you can't find me 😊). I assist smokers to quit that habit 😊. Even... some people claim that I am for relieving their stress, reducing their calorie intakes and increasing their concentration on work 😊. But don't take too much of me because it may cause jaw pain, head ache and tooth decay. Hope, you can't guess who I am 😊, so wait for our next issue 😊.



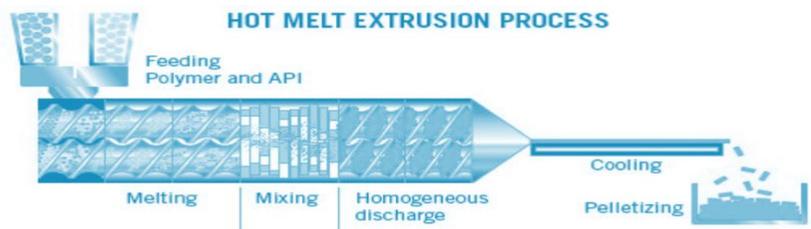
TORTILLA CHIPS

ANSWER FOR THE PREVIOUS EDITION

## FARM TO FORK:

VENKATSUBRAMANIAM.R

## EXTRUDED PRODUCTS:



HARVEST



THRESHING



TRANSPORT



CLEANING AND GRADING



DRYING



MILLING



MIXING AND KNEADING

(10 to 15mins in Hobart mixer)



FLAVORING AND COLORING

(Dough resting for 40mins)



ROLLING



EXTRUDING(Single screw)



CUTTING



DRYING(75c for 3h)



PACKAGING



DISTRIBUTION



CONSUMERS

Extruded products are one of the fastest growing segments in the present food industry. It provides a wide range of finished products from inexpensive raw materials with minimum processing time. Many new creative products can be produced by the process extrusion. Extrusion is a highly versatile unit operation which paves a way for most of the RTE food

Extruded products are preferred because it meets up demand of high nutrient foods with increasing human population. Food products manufactured using extrusion usually have a high starch content. These include pasta, breads (croutons, bread sticks, flat breads). Many breakfast cereals (Kellogg's corn flakes) ready to eat snacks, confectionery, premade cookie dough, some infant foods, full fat soy, texturized vegetable

protein, dry & semi moist pet foods, meat products & coextruded products. Consumer acceptance of extruded food products is mainly due to the convenience, value, attractive appearance and texture found to be particular for these foods, especially snack products. Extrusion process takes place a different series of steps for different products.

**1.Harvest:** Durum Wheat is preferred in manufacturing pasta. Durum Wheat is an amber coloured high hard wheat grown specifically for the manufacture of Pasta. *Triticum durum* is the species. It takes about seven to eight months to maturity and it creates pretty golden contrast in spring

**2.Threshing:** The threshing and separation of grains from straw is done in variety of ways. An old and simple improvement in threshing is to beat a sheaf of wheat and the grain heads against a low wall, an oil drum or a bed. This method is more efficient than trampling as the grains fall into a container or into a woven malt. Tractor driven threshers and at times combined harvesters are used.

**3.Transport:** Using an auger wheat is moved to the grain processing centre in a single trip, damped into a receiving bin by trucks, carried by a mechanical conveyor after cleaning and grading into storage. Next, they are moved to flour mill. Highly efficient bulk handling systems are preferred.

**4.Cleaning and Grading:** After threshing the straw, chaffs, immature grains, sand, stones and other impurities are separated from the grain by sieving, winnowing, hand picking, simple low-cost appliances that use hand driven or motorized blowers have been developed that are more efficient and less-time consuming than hand winnowing. Then the grains are graded using efficient graders to separate the grains according to their commercial value. Big sized grains are preferred for further processing.

**5.Drying:** Wheat is harvested at the moisture content of 25%(common) and dried to 14% to protect them from fungal and other microbial attack. Grains can be stored for long time (4-12 months) and can be used

when they are necessary. Can be stored in sheds, steel bins, concrete silos or holding bins of flour mill. Natural air, low temperature and high temperature dryers, in type, column or self-contained dryers, cross flow, counter flow, concurrent flow are the types of dryers. They can be used according to the industry, region and efficiency. Most commonly 130F above 20% moisture content is used.

**6.Milling:** To grind the wheat and to completely separate the bran and germ from the mealy endosperm into middling's and semolina. Bran contains more oil than the kernel. **Semolina** is a coarse, purified wheat middling's of durum wheat. Farina, rougher granulations

of other high-quality hard wheat is also used to make pastas, semolina and farina flour are enriched with vitamin B and iron before they are taken to pasta plants.

**7.Mixing and Kneading:** The semolina stored in giant silos are taken. Pipes move the flour to the mixing machine equipped with rotating blades. Warm water is also piped into the mixing machine. The mixture is kneaded to a lumpy consistency.

**8.Flavoring and colouring:** Eggs are added to the mixture if the product is an value added product (for example egg noodle).If pasta is to be a flavoured variety vegetable juices are added here. A tomato or beet mixture is added for red pasta, spinach for green pasta, carrots for orange pasta. Herbs and spices can also be folded in for additional flavouring.

**9.Rolling:** The mixture moves to a laminator where it is pressed into sheets by large cylinders. A vacuum mixer machine further flattens the dough while pressing air bubbles and excess water from dough to reach the optimum water content of 12%.

**10.Extruding:** The roll of dough moves through a steamer which heats the dough to 220F(104°C) in order to kill any existing bacteria and also high pressure is applied with the help of heaters and systems in extruders. Uniform flow rate is followed. Automatic press extruder pasta machine is common.

**11.Cutting** Depending on the type of noodle to be produced the dough is either cut or pushed through dies. Ribbon and string style pasta such as fettucine,linguine,spaghetti and cappellini are cut by rotating blades. To make tube or shell shaped pasta such as rigatoni,ziti,elbow,macroni and fusilli, the dough is fed into an extruder which then pushes it through metal dies. The size and shape of the holes in the die determine the type of pasta. To make vermicelli and cappellini the pasta dough is pushed through holes between 0.5-0.8mm in diameter. The cutting machine then cuts the pasta into lengths of 10 inches(250mm) and twists into curls. To make ravioli premeasured quantities of cheese filling are dropped by machine at intervals on a sheet of pasta. Another sheet of pasta is placed over this sheet as it moves along a conveyor belt. The two layers then passes under a cutting machine that perforates the pasta into premeasured squares.

**12.Drying:** The pasta is placed in a drying tank in which heat, moisture and drying time are strictly regulated. Ranges from 3hours for elbow macaroni and egg noodle to as much as 12hours for spaghetti's drying time is so critical if it is dried too quickly it will break or if dried slowly the chance of spoilage increase. The efficient dryers are used.

**13.Packaging:** Fresh pasta is folded in pre measured amounts into clear plastic containers. As container move along a conveyor belt a plastic sheet covers each container and is sealed in hot press. At the same time a small tube sucks the air pf the container and replaces it with a mixture of carbon dioxide and nitrogen to prolong product shelf life. Most of noodle goods are fragile so careful handling is necessary. The individual containers are placed in boxes and they are sealed.

**14.Distribution:** The boxes are distributed to the markets, wholesale dealers, further processing industries through trucks. The consumers buy them from the markets and they are consumed. Many breakfast cereals (kellogs corn flakes) ready to eat snacks, confectionery, premade cookie dough, some infant foods, full fat soy, texturized vegetable protein, dry & semi moist pet foods, meat products & coextruded products.

## SCIENCE DATA:

R. RAMYA SHREE

### HOT CHEETOS PUFFS

The three ingredients:

#### Thiamine-

Chemical Name- Thiamine

Chemical Formula-  $C_{12}H_{17}ClN_4OS$

Physical Properties- Melting point 200 C, Water soluble vitamin, non-flammable

Chemical Properties- it acts as a coenzyme in the decarboxylation

Health Effects- rare allergic reactions, and skin irritation

#### Ferrous Sulphate-

Chemical formula-  $FeO_4S$

Physical properties- Melting point 64 C, Sensitivity- air sensitive

Chemical properties- light blue, or light blue-green solid

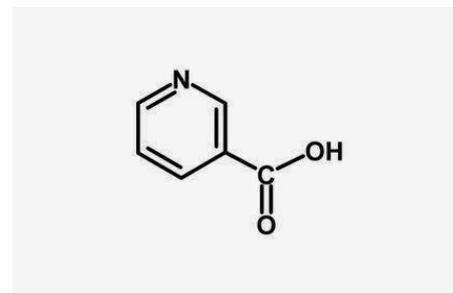
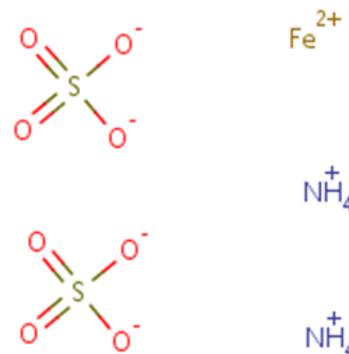
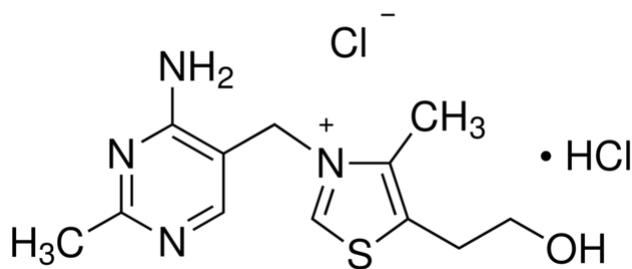
Health effects- Constipation, diarrhoea, stomach cramps, or upset stomach

#### Niacin-

Chemical name- niacin

Chemical formula-  $C_6H_5NO_2$

Physical and Chemical property- it's amide are thermally stable even when heated and not lose vitamin properties



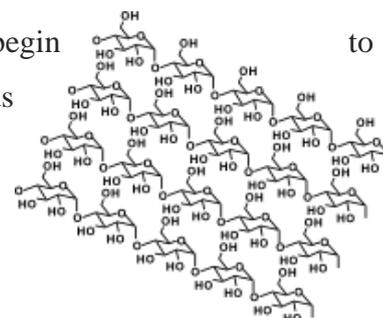
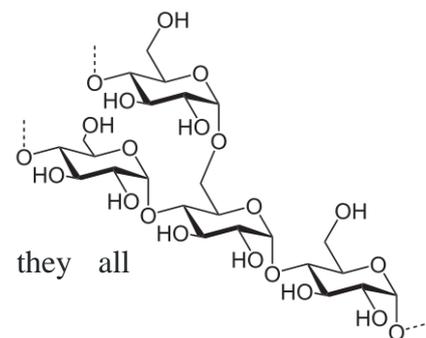
## PASTA

STARCH is made of glucose polymers.

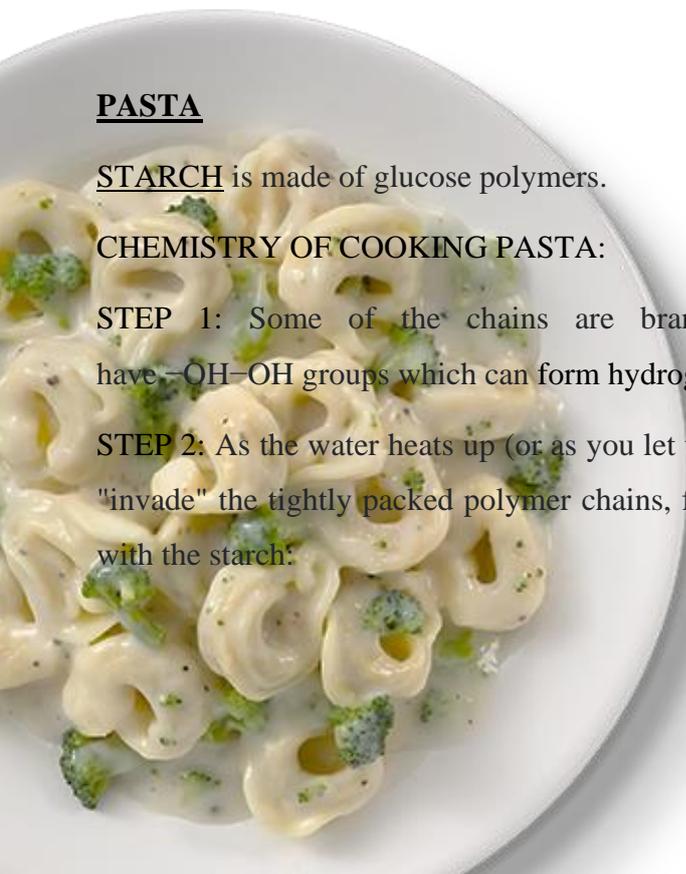
### CHEMISTRY OF COOKING PASTA:

STEP 1: Some of the chains are branched, some are linear, but they all have -OH-OH groups which can form hydrogen bonds with each other.

STEP 2: As the water heats up (or as you let the pasta soak), water molecules begin "invade" the tightly packed polymer chains, forming their own hydrogen bonds with the starch:

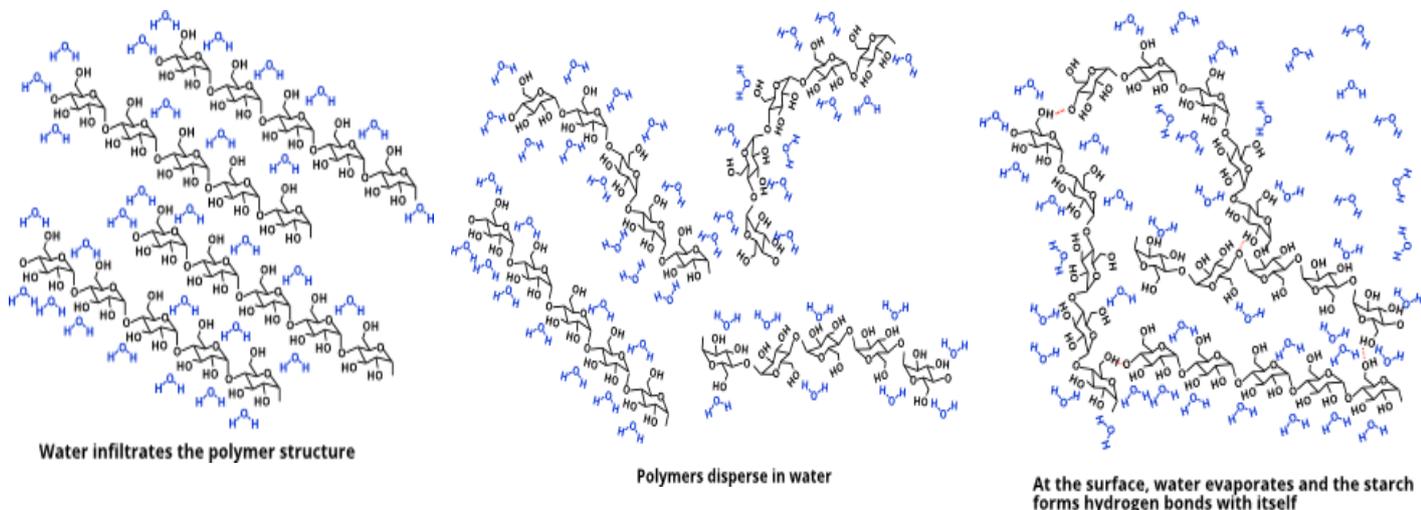


Starch polymers are nicely aligned



**STEP 3:** Soon, the polymer chains are completely surrounded by water, and are free to move in solution (they have dissolved):

**STEP 4:** The water continues to boil, the starch forms a loosely packed network of molecules connected by hydrogen bonds and surrounding little pockets of water and air (bubbles):

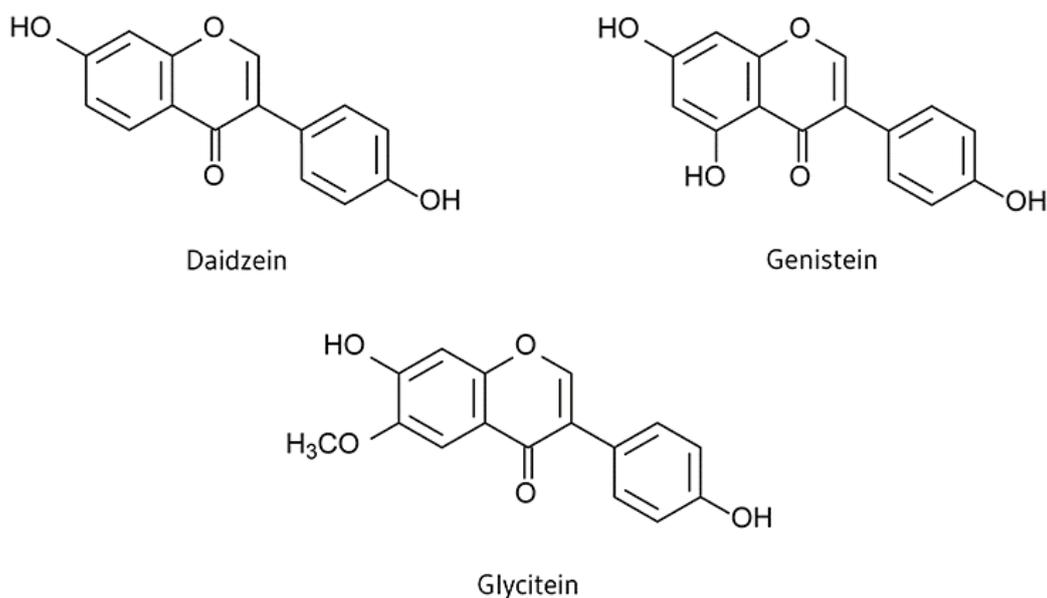


Some oil in the water will inhibit the bubbles from breaking the surface as easily, and a wooden spoon across the top will break the network mechanically as soon as it touches it.

## SOY ISOFLAVONES

Isoflavones are a class of phytoestrogens — plant-derived compounds with estrogenic activity. Soybeans and soy products which are extruded products are the richest sources of isoflavones in the human diet.

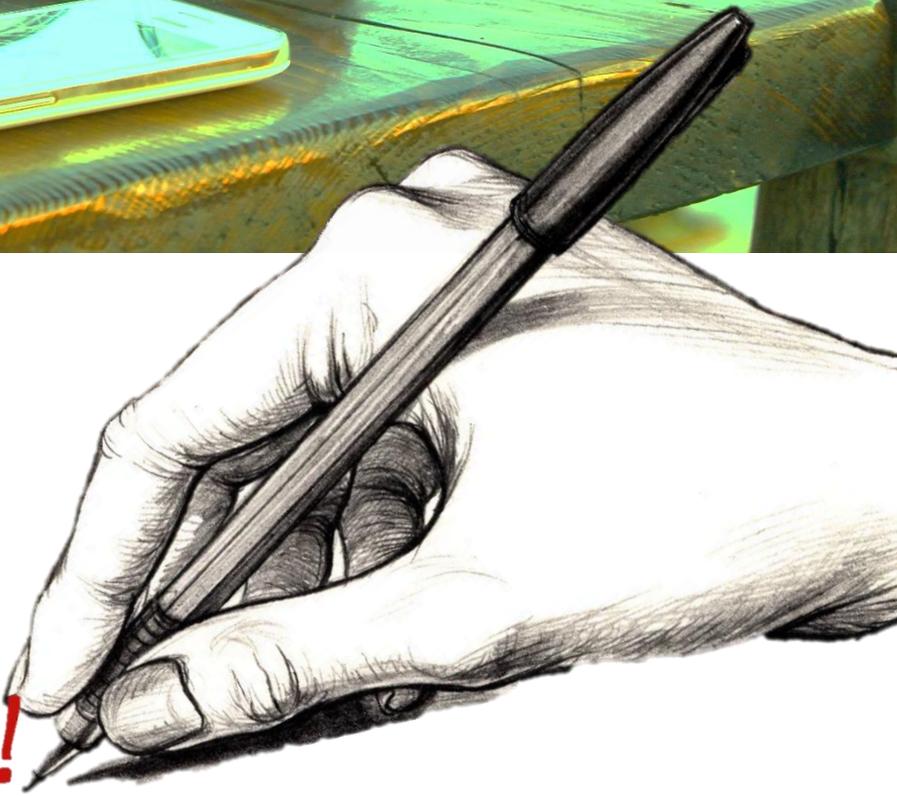
Figure 1. Chemical Structures of Major Soy Isoflavone Aglycones



**REFERENCE** <https://lpi.oregonstate.edu> <http://hotcheetopuffs.blogspot.com/>

<http://www.chemistryislife.com/t-8> <https://chemistry.stackexchange.com/>





COMICS !!





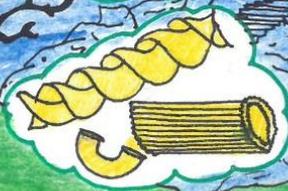
Hello wizards!  
Today we'll see  
About Extruded  
Foods

Extruded Snacks  
Other Name - Collet (or)  
Second Generation Snacks  
Twin Screw, high shear  
Extruders are used

Can anyone say  
about the pasta  
production

Yes, sir!

Milled wheat +  
water + Eggs  
Dough → Conveys → Compacts  
Kneads → Relaxes →  
Extrudes



Now! I'll explain about  
Extruded cereal  
Products

- ⇒ No Antinutritional factors
- ⇒ Low Viscosity when cooked
- ⇒ stable 12 months @ Ambient



Ron, Now can you say  
some example for  
Extruded snacks?

Yes sir!  
Kurkureey.

Nooo Ron!  
It's kunkure  
Not kurkureey!

Thank  
You!

IN THE MINION'S PASTA FACTORY  
MIXING PROCESS IS DONE...

1

I am gonna add durum wheat flour to prepare pasta base

Let me add water for the perfect consistent dough...!

SEMOLINA

GIR!!.. GIR!!..

FLAVOUR ADDITION

2

OMG!! There are a lot of options for flavours! Who am I gonna choose

EXTRUSION PROCESS

3

It is in perfect shape! Now the pasta is ready to dry...

CLACK! CLACK!...

DRYING PROCESS

4

This pasta has 12% moisture content. It is ready to pack...

PACKAGING PROCESS

5

Now these yummy Pasta's are ready for sale!!

PASTA ROYCO

6 PASTACIUTTA SHOP

PASTA CHINESE	PASTA ROYCO	PASTA SUN FEAST	PASTA CHILLY	PASTA CITAY	PASTA BAMB
PASTA CHINESE	PASTA ROYCO	PASTA SUN FEAST	PASTA CHILLY	PASTA CITAY	PASTA BAMB

Hey Bob! grab that pasta...

How about chinese pasta tonight!!...

## JOB OPPORTUNITIES:

ARUN, SYED AMMAL:

### Extruder Machine Operator

#### Job Description:

The Eligibility Criteria for the Above Posts is One Year/three Year Diploma/ with 1 Year to 5 Year Experience in Extruder plant.

**Work Experience:** 2 - 5 Years

**Qualification:** Diploma, B.Tech./B.E.

#### About Company:

K D Groups is a certified company and one of the leading Service providers based in Delhi NCR (Bahadurgarh). We are offering a wide range of services such as Manpower Recruitment Services Security Services, House Keeping Services, Transportation Services, Placement Services, Head Hunting, Verification Services and Resume Making Services.

**Location:** Haryana, India 124507

#### Key Skills:

Extruder, Machine Operator, Engineer, Diploma

#### QR code reference:



### Extrusion Process Engineer

#### Qualifications:

- 1 - 2 years single or twin-screw extrusion experience in food or pet food required
- Bachelor of Science or MS preferably in Chemical Engineering
- 5 to 10 years of food processing experience and/or training with extrusion technologies

#### Work experience:

- Experience with high-pressure extrusion; preferred single-screw extruders experience
- Strong extrusion knowledge and engineering technical skillset and experience

**About Company** At Heartland Harvest, we make great-tasting plant-based foods and snacks accessible to all always delicious, always nutritious, and always free from allergens. We are a small but mighty & committed team dedicated to bringing good-for-you ingredient products into the world.

**Location:** quaint town of Kankakee, Illinois 60901

#### Skills required:

- ✦ Strong computer skills for effective use of planning software tools and the Microsoft Office suite
- ✦ Partnering and working with cross-functional teams
- ✦ Excellent communications skills, both verbal and written, including presentation skills
- ✦ Excellent organizational skills
- ✦ Highly developed analytical reasoning skills
- ✦ Enthusiastic team player with strong interpersonal and relationship-building skills

#### QR code reference:



## BOOK ALERT

### Gokilavani A

**1.Book name:** Extrusion Processing Technology: Food and Non-Food Biomaterials

**Author's name:** Jean-Marie Bouvier, Osvaldo H. Campanella

**Publisher:** John Wiley & Sons

**Publication date:** June 23, 2014

**Price:** \$144.42

**Description:** The only up-to-date book on this important technology, Extrusion Processing Technology: Food and Non-Food Biomaterials bridges the gap between the principles of extrusion science and the practical "know how" of operational engineers and technicians. Written by internationally renowned experts with over forty years of experience between them, this valuable reference for food scientists, food engineers, chemical engineers, and students includes coverage of new, greener technologies as well as case studies to illustrate the practical, real-world application of the principles in various settings.

**2.Book name:** Food and Feed Extrusion Technology: An Applied Approach to Extrusion Theory

**Author's name:** Dennis Forte, Gordon Young

**Publisher:** Food Industry Engineering

**Publication date:** March 31, 2016

**Price:** \$174.53

**Description:** This book presents the theory behind extrusion technology, as used for food and feed products, in a way which can be readily applied in practice. It provides good fundamental understanding, but presented in the context of practical application, so that readers can understand how it applies in a real

manufacturing situation. This book is relevant to all types of extruded human foods and animal feeds, and all types of equipment used to produce them: single- and twin-screw extruders, and specialized snack food machines. It considers how the equipment and processes operate, and how the process conditions interact with the ingredients used. Understanding the theory behind the process - and how it applies in practice - means that formulations and processes can be designed to be more robust, appropriate equipment can be selected for the required duty, and effective operating procedures and guidelines can be developed - leading to reliable processes and consistent product. The authors bring decades of industry and research experience to this book.

**3.Book name:** Extrusion-Cooking Techniques: Applications, Theory and Sustainability

**Author's name:** Leszek Moscicki

**Publisher:** John Wiley & Sons

**Publication date:** January 11, 2011

**Price:** \$85.86

**Description:** Offering an engineering perspective and the latest information on the application of this rapidly expanding technique, this practical book covers the technology, engineering, materials and products, as well as economic and ecological aspects. In addition to the theory, it also utilizes case studies that can easily be put into industrial practice. Each step of the process is discussed in terms of sustainability, and all data complies with the EU and FTA environmental regulations. Invaluable reading for food chemists and technologists, process engineers, chemists in industry, agricultural scientists, and chemical engineers.



## Secrets that you don't know!

S. Sri Vasu Prada

**Noodles:** Although instant noodles provide iron, B vitamins and manganese, they lack fibre, protein and other crucial vitamins and minerals. Additionally, their MSG (Mono Sodium Glutamate) i.e. aji-no-moto and high sodium contents may negatively affect health, such as by increasing our risk of heart disease, stomach cancer and metabolic syndrome.

**Pasta** Although we think of pasta as a carbohydrate, eating pasta is actually a good way to get a little extra protein into our diet. One cup of cooked spaghetti, for example, can have as 8 grams of protein, and supplies our body with several amino acids that we need to stay healthy.

**Cheetos:** Cheetos are scientifically proven to be addictive! According to oxford study, the brain associates the crunching sound with freshness, so we might be convinced that what we are eating is more appetizing than it really is. There is a little thing called 'vanishing caloric density' which tricks our brain into

### BANG THE MYTH:

BHARATH.J

In recent days there is a great increase in demand of high meat extruded pet foods. But, challenges in inclusion of high meat in extrusion process is a considerable one. It is said that extruding high meat food with single screw extruder is a tedious process and quality of the product is comparatively poor. Many producers believed that only twin-screw extruder will be best suited for extruding high meat products. Common myths about using a single screw extruder for high-meat pet foods include:

- ❖ Those fresh meat inclusions must be heated.
- ❖ Dry pet foods with high levels of fresh meat, as well as limited ingredient diets, must be produced using a twin-screw extruder.
- ❖ Grain-free pet foods and those with high levels of fresh meat are fragile when extruded.
- ❖ That scientifically validating the safety of high fresh meat pet foods produced on a single screw extruder is challenging or suspect.

According to Dave Albin (PhD, applied nutrition technologist at Insta-Pro International) "High-meat,

believing that we are not getting enough of the tasty snack.

**Croutons:** 100 grams of croutons contain 465 calories, the 23% of our daily needs. Croutons have 7 milligrams of cholesterol and 18.3 grams of fat. It also contains some important vitamins such as vitamin B9, vitamin A, vitamin K.

**Frankfurters:** Frankfurters or franks, can be either be all beef or a beef and pork combination. After extrusion they are smoked and then cooked.

**Hot dogs and sausage:** The texture of a hot dog is smooth and paste like, while sausages have a more composite mixture of miniscule bits of meat. A hot dog is usually a food for leisure time, while a sausage can be eaten for the same purpose but can also be used in main dishes. Sausages reduces blood pressure and risk of cardiovascular disease.

dry pet foods can be produced with a single-screw, medium-shear extruder provided that dry animal ingredients are used". Raw, wet ingredients are much more challenging to work with, however moisture and fat in raw animal ingredients counteract friction in the extruder barrel making it very difficult, if not impossible, to achieve the appropriate cooking temperature. So, it is important to have inspection of the high variance ingredients and to accept ingredients that are in specific nature, this is the major issue to be considered with processing with single screw extruder. Further, many advances are made with single screw extruder for processing high meat inclusions to make it a cost-effective process that can be accomplished with a single screw without need of the twin-screw extruder. Thus, high meat inclusion pet food can be processed efficiently with single screw extruder with considering above said parameters to produce cost efficient and quality rich product.

REFERENCE: <https://www.petfoodindustry.com/articles/5690-the-challenges-of-extruding-high-meat-pet-food>