Status of Starch Sources in India, their Processing and Utilization

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- Starch, α-D glucan polymer - a major energy source in most diet

- Versatility and heterogeneity of application in the food industry

- The use of starch products as a food ingredient is usually not based on their nutritional value but on their functional value.

- Almost all major industries (food and non-food) have found some applications for starch.
Starch is widely found in:

- cereal grain seeds (e.g. corn, rice, wheat),
- tubers (e.g. potato),
- roots (e.g. sweetpotato, cassava, arrowroot),
- legume seeds (e.g. peas, beans),
- fruits (e.g. green bananas, unripe apples), and
- leaves (e.g. tobacco).
Starch can be simply manufactured by the combination of grinding the starch-rich crop followed by wet separation techniques.

The starch granules will sediment in water due to their higher density.

Three main classes of starch based products exist:

- unmodified or native starch,
- modified starch (dextrin, pre-gelatinized starch and oxidized starches) and
- sweeteners (glucose syrup, high fructose corn syrups).
OBJECTIVES

- To review recent trends in starch markets in India and examine the importance of cereals, root and tuber crops in the Indian starch industry.

- To assess the prospects for future growth of starch demand in India.
India has achieved 'food security'

The extraction and processing of starch from agricultural commodities is one of the most important agro-industries in India.

The starch industry in India differs in important ways from its counterpart the industrialized world, especially in terms of:

- rate of growth,
- industrial organization,
- pattern of commodity utilization, and
- influence of government policy.
Indian Production of Starch:

3,75,000 tonnes

Out of which:

1,87,000 tonnes -
used by the Food Sectors

From this:

1,57,600 tonnes –
used as hydrolytic products
### Polymeric Uses of Starch in: Starch industry in India

<table>
<thead>
<tr>
<th>Modified Starch</th>
<th>Advantages over Natural Starch</th>
<th>Food Uses</th>
<th>Non-food Uses*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregelatinized</td>
<td>cold water soluble</td>
<td>Pie-filling, coating</td>
<td>Oil drilling, mining</td>
</tr>
<tr>
<td>Acid-thinned</td>
<td>Low hot paste viscosity</td>
<td>Gums, jellies</td>
<td>Textiles, laundry</td>
</tr>
<tr>
<td>Oxidized</td>
<td>Increased clarity</td>
<td>Sauce thickener</td>
<td>Paper, textiles, adhesive</td>
</tr>
<tr>
<td>Ethers</td>
<td>Increased clarity</td>
<td>Salad dressing</td>
<td>Paper and textiles</td>
</tr>
<tr>
<td>Ester</td>
<td>Forms films /fibres</td>
<td>Instant Foods</td>
<td>Packaging film, paper</td>
</tr>
<tr>
<td>Phosphates</td>
<td>Stable to freeze-thaw property</td>
<td>Frozen foods</td>
<td>Textiles, metal refining</td>
</tr>
<tr>
<td>Crosslinked</td>
<td>Stable: heat, pH</td>
<td>Canned Food</td>
<td>Paper, metal sequester</td>
</tr>
</tbody>
</table>

*Biodegradability is an added advantage, in addition to sustainability*
Information about starch production, utilization and prices is sparse and incomplete.

Much of these data are held privately by firms who may be reluctant to share it due to market advantages.

What information is publicly available from government bodies or industrial associations usually focuses almost exclusively on the large-scale modern sector, ignoring starch extraction and use by small firms.

In India, small-scale firms are important players in the starch industry, especially for root and tuber crop starch processing and utilization.
Supply and Trade of Starch

- Globally, the commodities from which most starch is derived are maize, cassava, sweetpotato, potato and wheat.

- Root and tuber crops are relatively more important as sources of starch than cereal crops.

- Worldwide, the biggest user of starch is the sweetener industry.

- Most starch is used to make food products.

- Non-food industries tend to make up an increasing share of total starch consumption.
Several different kinds of starch substrates co-exist and are actively traded side by side.

Native starches derived from maize, cassava, sweetpotato, potato, and other crops are in regular supply.

Resumption of economic growth in the region has renewed the rapid expansion of the demand for starch.

Overall, demand for starch in India continues to grow at around 5 percent per year or more.

Agricultural policies do influence the price of cereal grains (especially rice and maize).

But the government rarely intervenes to influence prices of root and tuber crops.

Thus the Indian starch market provides an interesting opportunity to explore other starch sources for their commercial exploitation.
Cereals account for about one fifth of the consumption expenditure in India.

They are mainly consumed in the form of products obtained from primary processing.

Products from secondary processing are yet to gain mass acceptability in the country.

However, cereal processing, both primary and secondary, are expected to gain momentum to cater to changing lifestyles due to:

- increasing purchasing power,
- burgeoning middle class population,
- increasing number of women in the work force, and
- proliferation of media etc.
Rice, Wheat, Maize and Sorghum
- the four major cereals grown and consumed in India
RICE

- Rice is a staple food for 65% of the population in India.
- India is the second largest producer of rice in the world next to China.
- India produces around 78 million MT of rice against world's production of 540 million MT thus accounting for around 14% of rice world production.
- In India paddy occupies the first place both in area and production.
- Rice production in India has registered a higher average yield of 2618 Kg/ha.
- Around 10% of rice is processed into traditional products like popped rice, flaked rice etc. in the cottage industry.
- It is the largest consumed calorie source among the food grains in India.
- With a per capita availability of 73.8 kg it meets 31% of the total calorie requirement of the population.
• The crop occupies about 37% of the total cropped area and 44% of total production of food grains in India.

<table>
<thead>
<tr>
<th>Major Growing States</th>
<th>% Share of Total Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Bengal</td>
<td>16.39</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>13.38</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>12.24</td>
</tr>
<tr>
<td>Punjab</td>
<td>9.47</td>
</tr>
<tr>
<td>Orissa</td>
<td>7.68</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>7.38</td>
</tr>
<tr>
<td>Other States</td>
<td>33.46</td>
</tr>
</tbody>
</table>

• India is also one of the leading exporters of rice in the world market.
• Indian rice being highly competitive and has been identified as one of the major commodities for export.
• Modern rice mills are having high capacity and are capital intensive, although efficient.
• Small modern rice mills have been developed and are available in the market.
Status of Rice Milling Units in India

- At present it has a turn over of more than 4320 million € per annum.
- It processes about 85 million tonnes of paddy per year.
- Over 82,000 single hullers of which are registered in the country.
- 60% of these are also linked with par-boiling units and sun-drying yards.
- Most of the tiny hullers of about 250-300 kg / hr capacities are employed for custom milling of paddy.
- Double hulling units ~ over 2,600
- Under-run disc shellers cum cone polishers ~ 5,000 units
- Rubber roll shellers cum friction polishers ~ over 10,000 units
- There has been a steady growth of improved rice mills in the country.
- Most of these have capacities ranging from 2 tonnes / hr to 10 tonnes / hr.
Uses of rice and by-products in the rice industry
WHEAT

- Wheat accounts for around 30% of the total cereal production in the world.

- The major producers of wheat are China, the former USSR, USA followed by India.

- Indian wheat yield stands at around 2397 Kg/ha.

- India's production in 2006-07 is 73.7 million MT.

- About 80% of wheat is milled in 'atta chakkis' (indigenous mills).

- Around 20% is milled in roller flour mills.

- Wheat flour is processed mainly into Indian traditional products, bread and biscuits and to a small extent to pasta products.
Wet Milling of Wheat Flour

Types of Processes

- The Alkali Process
- The Martin Process
- The Batter Process
- The Alfa-Laval System
- Innovative 3-phase technology
Industrial uses of wheat starch

- Wheat starch is a versatile commodity.
- Utilized for the production of syrups for the food and beverage industries
- Utilized for fruit pie fillings, after modification
- As a molding starch in the confectionery industry
- As a binder in tablet making in pharmaceutical industry (being non-toxic and compatible with a wide range of drugs)
- Paper-making industry
- Thin-boiling starches
- Starch ethers, esters, xanthates etc.
Maize (Zea mays) is classified into following categories:

- Dent corn (Zea mays var. indentata)
- Flint corn (Zea mays var. indurata)
- Popcorn (Zea mays var. everta)
- Sweet corn (Zea saccharata or Zea rugosa)

Indian maize has white, red, purple, brown or multi-coloured kernels and is characteristically dent corn.

The dent corn is useful for starch processing by wet milling method.
Production of Maize

- India is the tenth largest producer with a production of 11.10 million MT from an area of 6.6 million ha.

- The average yield in India ~ 1.68 MT/ha

- About 4 million MT is used as animal feed, about 5 million MT is dry milled and 2 million MT is wet milled.

- Maize is cultivated in almost all states in the country.

- Bihar is the leading producer in India followed by Rajasthan, Madhya Pradesh, Uttar Pradesh, Andhra Pradesh, Karnataka and Himachal Pradesh.

- The crop is grown both in Kharif and Rabi seasons in India with a share of 85 per cent and 15 per cent, respectively.
Utilization Pattern of Maize

Maize produced in India is utilized for

- human consumption (33%),
- starch production (9%),
- poultry feed (46.5%),
- brewery (0.5%) and
- animal feed (11%)

The market surplus of maize in India as compared to other crops is quite low between 5-10 per cent.
Traditionally, the grain is converted into flour in mills for making bread.

Immature cobs are roasted and eaten all over the country.

It is an important raw material for animal and poultry feed and corn flakes manufacturing units.

But the quantity of maize utilized by these units is limited as the existing units are of small scale nature (except very few viz., Mohan Meakin, Ghaziabad and Kellogs).

Maize is usually processed by two distinct processes, namely wet milling and dry milling.
Dry Milling

- Dry milling produces grits, corn flour and minimum amount of corn meal.

- The technology has been standardized by CFTRI, Mysore.

- The grits is the main product of dry milling process, which is used as porridge by boiling domestically.

- The processing units use grits for manufacture of products like ready-to-eat snacks (corn flakes), wall paper paste and manufacture of glucose by direct hydrolysis.

Cleaning => Conditioning => Degerminating => Drying & Cooling => Grading & Grinding => Sifting & Classifying => Purifying => Drying => Packaging
Maize is generally processed to manufacture corn starch by wet milling method the world over.

The average recovery of various products and co-products of maize during the wet milling are:
- Starch: 60-62%
- Gluten: 8-9%
- Germ: 6-7%
- Husk: 22-24%

The by-products of starch manufacture, like corn oil, corn steep liquor, gluten etc. are the important value added products.
The state-wise number of wet milling units in India and their installed capacity

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of the State</th>
<th>No. of units</th>
<th>Installed capacity (MT of maize/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gujarat</td>
<td>6</td>
<td>1,350</td>
</tr>
<tr>
<td>2</td>
<td>Maharashtra</td>
<td>5</td>
<td>1,050</td>
</tr>
<tr>
<td>3</td>
<td>Madhya Pradesh</td>
<td>3</td>
<td>450</td>
</tr>
<tr>
<td>4</td>
<td>Karnataka</td>
<td>1</td>
<td>300</td>
</tr>
<tr>
<td>5</td>
<td>Punjab</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>Chhatisgarh</td>
<td>1</td>
<td>150</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td><strong>17</strong></td>
<td><strong>3,400</strong></td>
</tr>
</tbody>
</table>

- The average processing capacity of the units in India is 200 MT of maize / day.
- There are plants with as high crushing capacity as 400 MT/day.
- However, there is no plant in the country with crushing capacity of less than 100 MT/ day.
The total world production of Sorghum is around 70 million MT with USA accounting for 32% of the production.

India is the second largest producer for sorghum accounting for around 18% of world production.

However, India's yield at 897 Kg/Ha is significantly lower than the world average of 1542 Kg/Ha.

About -'300 million people across the world rely on sorghum for their sustenance.

In India, 60% of sorghum is utilized for food purposes.

Around 35% is consumed as animal feed and for industrial uses.

Remaining 5% is used for seed purpose.

The secondary processing of sorghum produces alcohol and sugar from sorghum starch.

India has been exporting sorghum to the tune of Rs.35-40 million in a year.
BUCKWHEAT

- About 75% of the grain produced is used for livestock and poultry.
- About 5-6% for seed
- The remainder is milled into buckwheat flour.
- Between 5-10% of the seeded acreage was turned under for green manure.
- Today, the major use of buckwheat is for human food in the form of flour.
- The flour is generally dark colored due to presence of hull fragments not removed during the milling process.
- Buckwheat flour is never produced from tartary buckwheat because of a bitter taste that makes it undesirable as human food.
- The groats are used for breakfast food, porridge, and thickening materials for soups, gravies, and dressings.
- Buckwheat is a satisfactory partial substitute for other grains in feeding livestock.
MAJOR USES OF BUCKWHEAT

- Pasta (elbow macaroni, and long goods)
- Puffed snacks (100% buckwheat flour)
- Indian Traditional Foods – Chapati, Tandoori Roti, Poori, Paratha, Pakoras
- Starch: As a fat replacer
- Dietary fiber
- Gluten free foods
Primary processing of buckwheat includes cleaning, dehulling, and milling.

The aim of dehulling is to separate the groats from the hulls by impact or abrasion of seed against emery stones or steel followed by air or screen separation of groats and hulls.

The most important quality attributes of buckwheat groats are color and flavor.

The color is light green in freshly harvested seed, but gradually changes to reddish brown during storage.

The color change is accompanied by loss of desirable flavor, nutrients, and formation of brown pigments.
Status of Root and tuber crops in the Indian industry
Major Root & Tuber crops grown in India

- **Cassava** *Manihot esculenta*
- **Sweetpotato** *Ipomoea batatas*
- **Yams** *Dioscorea alata, D. esculenta, D. rotundata*
- **Elephant foot yam** *Amorphophallus paeoniifolius*
- **Taro** *Colocasia esculenta*
- **Tannia** *Xanthosoma sagittifolium*
- **Coleus** *Solenostemon rotundifolius*
- **Yam bean** *Pachyrhizus erosus*
- **Arrowroot** *Maranta arundinacea*
- **Potato**
There is a major demand for starch from root and tuber crops due to the special characteristics of the starches from these commodities.

For root crops, transforming the raw commodity into starch effectively transforms its demand from an inferior good to a normal or superior good.

In India, where cassava is the most important source of starch, more than 20 percent of total cassava production is used for starch extraction.

Sweetpotato is not widely used for starch because of the availability of cheaper starch from cassava.

Processing of roots and tubers tends to be done near centers of crop production due to their perishability, the bulkiness and high transportation cost relative to crop value.
WATER CHESTNUT

- Water Chestnut (*Trapa natans* L. var. bispinosa Roxburgh), locally known as ‘Singhara’

- One of the important annual aquatic warm season crops

- Water chestnut belongs to the family *Trapaceae*

- A native of Asia but has spread to many parts of the world in both temperate and tropical areas
Production

- Cultivated extensively for its fruit in tanks, lakes, ponds, etc.
- Water chestnut prefers warm and humid environment.
- Water chestnut worth Rs. 20 million (0.3 million €) is produced annually in Jabalpur district (Madhya Pradesh) alone.
- In Punjab, areas in Gurdaspur, Harike, Amritsar etc. are major producers of the fruit.
- Extremely profitable, giving Rs. 55000 (950 €) per hectare
Nutritional Information

A typical composition of fresh kernel (in percent) is

- **Moisture**: 70.0
- **Protein**: 4.7
- **Fat**: 0.3
- **Fibre**: 0.6
- **Other carbohydrates**: 23.3
- **Minerals**: 1.1

Also contains a plentiful B vitamins (including B1, B2, B5 and B6), E, A, and vitamin C.
USES

- Can be used as a vegetable, roasted, steamed, boiled, puréed as a main component of soups, ground into flour for confectionery use.
- Used not only as food to combat malnutrition but also used for manufacturing starch and flour.
- Flour to make Indian traditional flat breads.
- Water chestnut flour consumption is high in days of fasts during festivals.
- Have a cooling effect and useful against bilious affections and diarrhoea.
- People also employ these nuts externally.
- Isolation of Gallic acid from the Singhara nuts.
- As a binding material in various products.
SWEETPOTATO

Sweet potato plays an essential role in the tropics as a food security crop because of its

i. relative tolerance to water stress

ii. dual utilization

iii. high nutritional value

iv. relatively short growing season, and

v. adaptation to a wide range of environmental conditions.
India has a long history of sweet potato cultivation.

It is presently cultivated in about 160,000 ha with plantings in the Bihar and Uttar Pradesh areas accounting for 60% of the total area.

In the Bihar area alone, 51,390 ha are cultivated with an annual production of 3.5 lakh tonnes.

Sweetpotato is the third most-produced crop after potato and cassava and government prospects is to cultivate about 2.5 million ha by the year 2020.
Goutam

- Round / ovate shaped tubers
- White skin and cream flesh
- Duration – 105-110 days
- Yield: 20-30 t ha-1

Sourin

- Round, elliptic shaped tubers
- Red skin and cream flesh
- Duration – 105-110 days
- Yield: 16-32 t ha-1

Kishan

- Long elliptic shaped tubers
- Purple skin and white flesh
- Duration – 110-120 days
- Yield: 17 - 26 t ha-1
- The sweetpotato (*Ipomoea batatas*, morning-glory family) is an enlarged storage root that comes in various shapes, sizes, and colors.

- The storage root is the main part of the sweetpotato that is used for food.

- In India, sweetpotato tubers are cleaned, sliced, and dehydrated in the sun in open yards.

- They are ground and used as a supplement to cereal flours in bakery products, chapattis, and puddings.

- Sweetpotato has high moisture content and a relatively low dry matter content of around 30 percent.

- Approximately 80-90 percent of its dry matter is carbohydrate.

- This makes sweetpotato roots a good raw material for the starch industry.
Sweetpotato Starch

- It has unique characteristics and potential for being used by the food industry.

- The starch is also processed into glucose syrups and various chemicals through enzymatic, microbial and chemical processes.

- In fresh roots, starch content ranges from 11 to 30% in 31 Indian cultivars.

- 1-ton native starch from 6.67 tons fresh root can be produced (15% starch extraction rate).
India produces cassava almost exclusively in the South.

Intensive cultivation practices result in the world's highest mean yields for cassava, of 24.5 t/ha.

Cassava is mainly used as food (Kerala) or starch extraction (Tamil Nadu).

An increasing trend toward use of cassava as a raw product for starch production is seen in India.

The industry is very dynamic, with increasing international investment.
Cassava cultivation in India (Area - %)

- Kerala: 46%
- Tamil Nadu: 41%
- Other States: 13%

Legend:
- Blue: Kerala
- Pink: Tamil Nadu
- Green: Other States
Cassava production in India (%)
## Area & Production of Cassava in different states in India

<table>
<thead>
<tr>
<th>State</th>
<th>Area ('000ha)</th>
<th>Production ('000 tns)</th>
<th>Productivity (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerala</td>
<td>109.3</td>
<td>2563.5</td>
<td>23.454</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>97.2</td>
<td>3425.5</td>
<td>35.242</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>18.1</td>
<td>111.5</td>
<td>6.16</td>
</tr>
<tr>
<td>Meghalaya</td>
<td>4.0</td>
<td>21.5</td>
<td>4.9</td>
</tr>
<tr>
<td>Assam</td>
<td>2.8</td>
<td>13.4</td>
<td>4.786</td>
</tr>
<tr>
<td>Karnataka</td>
<td>0.8</td>
<td>6.6</td>
<td>8.25</td>
</tr>
<tr>
<td>Nagaland</td>
<td>0.8</td>
<td>15.8</td>
<td>19.5</td>
</tr>
<tr>
<td>Sikkim</td>
<td>0.5</td>
<td>1.2</td>
<td>3.0</td>
</tr>
<tr>
<td>Mizoram</td>
<td>0.2</td>
<td>0.2</td>
<td>3.0</td>
</tr>
<tr>
<td>Rajastan</td>
<td>0.1</td>
<td>0.4</td>
<td>4.0</td>
</tr>
<tr>
<td><strong>India</strong></td>
<td><strong>234.8</strong></td>
<td><strong>6181.1</strong></td>
<td><strong>26.325</strong></td>
</tr>
</tbody>
</table>
# Cassava Varieties

<table>
<thead>
<tr>
<th>Name</th>
<th>Duration (months)</th>
<th>Av. Yield (t ha⁻¹)</th>
<th>Starch (%)</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>H 97</td>
<td>10</td>
<td>25-35</td>
<td>27-31</td>
<td>Industry</td>
</tr>
<tr>
<td>H-165</td>
<td>8-9</td>
<td>33-38</td>
<td>28-30</td>
<td>Industry</td>
</tr>
<tr>
<td>H-226</td>
<td>10</td>
<td>30-35</td>
<td>28-30</td>
<td>Industry</td>
</tr>
<tr>
<td>Sree Visakham</td>
<td>10</td>
<td>35-38</td>
<td>25-27</td>
<td>Edible</td>
</tr>
<tr>
<td>Sree Sahya</td>
<td>10-11</td>
<td>35-40</td>
<td>29-31</td>
<td>Edible</td>
</tr>
<tr>
<td>Sree Prakash</td>
<td>7</td>
<td>30-35</td>
<td>29-31</td>
<td>Edible/Ind</td>
</tr>
<tr>
<td>Sree Harsha</td>
<td>10</td>
<td>35 – 40</td>
<td>38-41</td>
<td>Industry</td>
</tr>
<tr>
<td>Sree Jaya</td>
<td>6-7</td>
<td>26-30</td>
<td>24-27</td>
<td>Edible/Ind</td>
</tr>
<tr>
<td>Sree Vijaya</td>
<td>6-7</td>
<td>25-28</td>
<td>27-30</td>
<td>Edible</td>
</tr>
<tr>
<td>Sree Rekha</td>
<td>10</td>
<td>45-48</td>
<td>26-28</td>
<td>Edible</td>
</tr>
<tr>
<td>Sree Prabha</td>
<td>10</td>
<td>30-35</td>
<td>26-28</td>
<td>Edible</td>
</tr>
<tr>
<td>Co.1</td>
<td>8-9</td>
<td>30</td>
<td>35</td>
<td>Industry</td>
</tr>
</tbody>
</table>
Uses of Cassava in India

- **Home front** – Food for human being, Component in animal, fish and poultry feed, chips, wafers, vermicelli, pappads

- **Industrial front** – Starch, Sago, Ethanol, Glucose, Biodegradable plastics

- **Value addition** - alcohol, modified starches, high fructose syrup, convenient fast foods, biodegradable plastics etc.
# Identification and evaluation of new cassava opportunities in India

<table>
<thead>
<tr>
<th>Market opportunity</th>
<th>What is required for the development of the opportunity?</th>
<th>What are the major limitation or barriers to the expansion</th>
<th>Who are the Catalysts and Champions? What is their role?</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Food: Diversified domestic convenience food</td>
<td>- On farm multi-purpose starch extraction units for cassava and sweet potato</td>
<td>- Lack of awareness</td>
<td>Catalysts:</td>
</tr>
<tr>
<td>- Feed on farm utilization</td>
<td></td>
<td>- Publicity</td>
<td></td>
</tr>
<tr>
<td>- Modified starches, converted starches</td>
<td></td>
<td>- Financing</td>
<td>- Government organizations</td>
</tr>
<tr>
<td>- Fermented products</td>
<td>- Organize cooperative marketing in semi-urban areas</td>
<td></td>
<td>- NGO's</td>
</tr>
<tr>
<td>- Instant convenient industrial food products</td>
<td></td>
<td></td>
<td>- Village Coops. - Women Coops. -Societies</td>
</tr>
<tr>
<td>- Chemicals</td>
<td>- Complete involvement of private sector</td>
<td>- Lack of confidence in product development and marketing</td>
<td>Champions:</td>
</tr>
<tr>
<td>- Biodegradable plastics</td>
<td></td>
<td></td>
<td>- Farmers -Small scale processors and industrialists</td>
</tr>
</tbody>
</table>
Industrial utilization of cassava in India (in lakh tonnes/annum)

<table>
<thead>
<tr>
<th>Cassava product</th>
<th>Current Utilization</th>
<th>Projection for 2020 AD</th>
<th>Requirement by 2020 AD</th>
<th>Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starch</td>
<td>1.5</td>
<td>2.5</td>
<td>3.0</td>
<td>-0.5</td>
</tr>
<tr>
<td>Sago</td>
<td>1.5</td>
<td>2.5</td>
<td>2.4</td>
<td>-0.1</td>
</tr>
<tr>
<td>Dry Chips</td>
<td>1.0</td>
<td>1.5</td>
<td>1.2</td>
<td>+0.3</td>
</tr>
<tr>
<td>Wafers</td>
<td>0.02</td>
<td>0.05</td>
<td>0.1</td>
<td>-0.05</td>
</tr>
</tbody>
</table>
Industrial utilization of **cassava starch** in India

<table>
<thead>
<tr>
<th>Industry</th>
<th>Utilization Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textiles</td>
<td>40-50 %</td>
</tr>
<tr>
<td>Adhesives</td>
<td>20-25 %</td>
</tr>
<tr>
<td>Food</td>
<td>10 %</td>
</tr>
<tr>
<td>Pharmaceuticals, Liquid glucose, modified starches</td>
<td>5-10 %</td>
</tr>
<tr>
<td>Vitamin C, Maltodextrins, Citric acid, Ethanol, Biodegradable plastics etc.</td>
<td>5 %</td>
</tr>
</tbody>
</table>


- **Starch** is the most important value added product produced from **cassava**.

- Approximately 400-500 starch processing units are located in Salem, Namakkal, Erode, Dharmapuri, Tiruchirapalli districts in Tamil Nadu.

- Only one industry in Andhra Pradesh produces **cassava** starch and liquid glucose from **cassava** starch.

- Some units in Kerala manufacturing white and yellow dextrins.

- 90% of the **cassava** starch produced in **India** is from Tamil Nadu while the remaining quantity is from Andhra Pradesh and Kerala.

- **Cassava** starch is mainly marketed in Gujarat, Maharashtra, West Bengal and Tamil Nadu.

- **India** exports **cassava** starch though in small quantities from Chennai, Mumbai and Kolkata ports to Sri Lanka, USA, Australia, South Africa and the Gulf Countries.
Sago

- Sago is an important value added product from cassava.
- Payasam, Kichidi, Upuma, Bonda, wafers – different products from sago
- In West Bengal, sago is used mostly as baby food.
- Sago production units are located in Sagoserve, Salem, Tamil Nadu and A.P.
- Moti, medium, bada dana and nylon sago are the different types of sago produced in the country.
- Nearly 400 to 500 sago producing units are located in Tamil Nadu and 35 units are located in A.P.
- 50% of the sago produced in the country is consumed in Maharashtra.
- Demand for sago is generally more during festival seasons and in Sravana month (August) due to more marriages being held then.
- Nowadays in the retail market, sago is marketed through attractive consumer packets of one kg and two kg size.
VALUE ADDITION : HOME FRONT TECHNOLOGIES
STARCH-BASED BIODEGRADABLE PLASTICS

SALIENT FEATURES

- Commercially proven technology
- Can be easily adopted by the existing plastic manufacturers
- Can be made into films, sheets & injection moulded into various products
- The film possesses adequate mechanical strength and flexibility
- It can be pigmented, printed and heat sealed like normal plastics
- Biodegradation time 6 months to 5 years
- Patented in India and abroad
The world’s fourth important food crop after wheat, rice and maize

An annual global production of about 300 million tonnes

Potato is an economically important staple crop in both developed and developing countries.

India is ranked 5th in potato production after China, Russian Federation, Poland and Ukraine.

However, potato productivity in India is merely 16-19 tonnes / ha vis-à-vis that of European countries and USA, i.e. 30-40 tonnes / ha.

Potato is used mainly for the direct consumption and starch.
SWOT ANALYSIS OF AGRO-PROCESSING INDUSTRY INFRASTRUCTURE IN INDIA
Strengths

- Round the year availability of raw materials.
- Social acceptability of agro-processing as important area and support from the central government.
- Vast network of manufacturing facilities all over the country.
- Vast domestic market.
Weaknesses

- High requirement of working capital
- Low availability of new reliable and better accuracy instruments and equipments
- Inadequate automation w.r.t. information management.
- Remuneration less attractive for talent in comparison to contemporary disciplines.
- Inadequately developed linkages between R&D labs and industry.
Opportunities

- Large crop and material base in the country due to agro-ecological variability offers vast potential for agro processing activities.

- Integration of developments in contemporary technologies such as electronics, material science, computer, bio-technology etc. offer vast scope for rapid improvement and progress.

- Opening of global markets may lead to export of our developed technologies and facilitate generation of additional income and employment opportunities.
Threats

- Competition from global players
- Loss of trained manpower to other industries and other professions due to better working conditions prevailing there may lead to further shortage of manpower.
- Rapid developments in contemporary and requirements of the industry may lead to fast obsolescence.
CONCLUSION
<table>
<thead>
<tr>
<th>Name of crop</th>
<th>Major production Areas/Regions</th>
<th>Total area under cultivation (million hectares)</th>
<th>Total crop production (million tonnes)</th>
<th>Various forms of crop utilization</th>
<th>Various forms of starch utilization</th>
<th>Future Perspectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cassava</td>
<td>Kerala, Tamil Nadu, Karnataka, Andhra Pradesh</td>
<td>0.24</td>
<td>6.06</td>
<td>Cassava rawa, porridge, cutlets, puffs and samosas</td>
<td>Alcohol, gums, dextrin, cold water soluble starch, biodegradable plastics, adhesives, starch succinate, thickener, solidifying agent in tissue culture</td>
<td>Value added products from starch, animal feed formulations, high fructose syrups and convenience foods</td>
</tr>
<tr>
<td>Name of crop</td>
<td>Major production Areas/Regions</td>
<td>Total area under cultivation (hectares)</td>
<td>Total crop production (tonnes)</td>
<td>Various forms of crop utilization</td>
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<tr>
<td>Sweet potato</td>
<td>Vishakhapatnam, Nellore, Chittoor, East of Godavari</td>
<td>787</td>
<td>8781</td>
<td>As boiled or fried vegetable, snacks, stuffing in various traditional recipes, flour as an ingredient in other foods with the other basic ingredients</td>
<td>Bakery, noodles, pasta and industrial applications like other starchy material</td>
<td>Can be used for the production of biodegradable plastics, cost effective alternative in food industry and value addition</td>
</tr>
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<tr>
<td>Buckwheat</td>
<td>Himalayan regions, Andhra Pradesh</td>
<td>-----</td>
<td>-----</td>
<td>Pancakes, bread, pasta, roasted seeds, noodles, extruded products, breakfast cereals</td>
<td>Pasta products, extrudates, and convenience foods</td>
<td>Product diversification and industrial exploitation.</td>
</tr>
<tr>
<td>Name of crop</td>
<td>Major production Areas/Regions</td>
<td>Total area under cultivation (lakh hectares)</td>
<td>Total crop production (Million tonnes)</td>
<td>Various forms of crop utilization</td>
<td>Various forms of starch utilization</td>
<td>Future Perspectives</td>
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<tr>
<td>Rice</td>
<td>Punjab, Haryana, Uttar Pradesh, Orissa and West Bengal</td>
<td>8.81</td>
<td>85.3</td>
<td>Cooked grains, baked products, noodles, pasta and extrudates, porridge, flattened bread.</td>
<td>Thickening agent in food industry, adhesives, gums, food products like baked, pasta and extruded products. Waxy starch in food and non-waxy as fat replacer. Low glycemic index food, starch based sport beverages</td>
<td>Value added products from starch, Convenient foods, in isolated or in situ form in functional / nutraceutical foods</td>
</tr>
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<tr>
<td>Wheat</td>
<td>Punjab, Uttar Pradesh, Tamil nadu, Karnataka, Haryana, Rajasthan</td>
<td>26.4</td>
<td>73.7</td>
<td>Chapatti, puri, snacks, Bread and biscuits, pasta, noodles, porridge, semolina, vermicelli etc.</td>
<td>Bioethanol production, gums, adhesives, food products.</td>
<td>Starch modification and its food and industrial application</td>
</tr>
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<tr>
<td>Water Chestnut</td>
<td>Punjab, Utter Pradesh, Madhya Pradesh, Bihar, Orissa, Karnataka</td>
<td>-----</td>
<td>-----</td>
<td>As vegetable, flour as important ingredient in various dishes, Chapatti, Halwa and baked products etc.</td>
<td>Thickener, Stabilizer, gelling agent, Bulking agent, Water retention agent and adhesive, as a binding agent in various sweets</td>
<td>Modified starches can be used for the value addition and product diversification to meet the food requirement in scarcity.</td>
</tr>
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</tr>
<tr>
<td>Maize</td>
<td>Rajasthan, Punjab, Himachal Pradesh, Utter Pradesh and Karnataka</td>
<td>6.6</td>
<td>11.10</td>
<td>Roasted or boiled grain products, in soups, flour for the chapatti, halva, as a supplement in bread, biscuit, and various extruded products</td>
<td>High fructose corn syrup, used in convenience foods, gums and adhesives, Nutritive media for the microbiological assay.</td>
<td>Used as an alternative for cane sugar, process optimization to produce quality products</td>
</tr>
<tr>
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<td>---------------------</td>
</tr>
<tr>
<td>Potato</td>
<td>Utter Pradesh, West Bengal, Bihar</td>
<td>1.37</td>
<td>23.67</td>
<td>As vegetable, Potato flour as a supplement in various dishes, used as stuffing in various fried salty and sweet products, French fries, soups etc.</td>
<td>Gum and gel preparation, used in noodles, pasta, soups, and extruded products etc.</td>
<td>Modified starch and its application in industrial and culinary purposes</td>
</tr>
</tbody>
</table>
# State-wise List of Starch Industries in India

<table>
<thead>
<tr>
<th>State</th>
<th>Industries</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Madhya Pradesh</strong></td>
<td>Rajaram Corn Products Ltd, Tirupathi Starch Products Ltd, Indore</td>
</tr>
<tr>
<td><strong>Tamilnadu</strong></td>
<td>Santhosh Maize &amp; Industries Ltd, Salem, Varalaxmi Starch Ltd, Salem, Kamala Sugars Ltd, Coimbatore</td>
</tr>
<tr>
<td><strong>Andhra Pradesh</strong></td>
<td>Gayathri Starch Ltd, Hyderabad, Vensa Biotek Ltd, Samalkot</td>
</tr>
<tr>
<td><strong>Punjab</strong></td>
<td>Sukhjit Starch Products Ltd, Phagwara</td>
</tr>
<tr>
<td><strong>Haryana</strong></td>
<td>Bharat Starch Products Ltd, Haryana</td>
</tr>
<tr>
<td><strong>Gujarat</strong></td>
<td>Anil Starch Products Ltd, Ahmedabad Maize Products Ltd, Ahmedabad, Gujarat Ambuja Starch Products Ltd, Ahmedabad, Gulshan Polyols Ltd, Bharuch</td>
</tr>
<tr>
<td><strong>Karnataka</strong></td>
<td>Riddhi Siddhi Glucobiols Ltd, Belgaum</td>
</tr>
<tr>
<td><strong>Maharashtra</strong></td>
<td>Sahyadri Starch &amp; Industries Ltd, MIDC, Miraj, Universal Starch Products Ltd, Dhule, Yaswant Glucose Ltd, Sangli</td>
</tr>
</tbody>
</table>
Major End-Users of Starch and Starch based Products

- Hindustan Lever Ltd.
- Colgate Palmolive Ltd.
- Lotte India Ltd.
- Perfetti Vanmelle India Ltd.
- Nutriene Confectionary Ltd.
- ITC Limited.
- Wrigley India Ltd.
- Cadbury India Ltd.
- Aviat Chemicals Ltd.
- Hindustan Latex Ltd.
- Glaxo Smithkline Ltd.
- Kissan Foods Ltd.
- Marico Oil Industries
- Merck India Ltd.
- Kamani Oil Mills.
- Wardex Laboratories Ltd.
- Griffon Labs Ltd.
- Emcure Pharma Ltd.
- Britannia India Ltd.
- Godrej Agrovet Ltd.
- Modern Food Industries Ltd.
- Nestle India Ltd.
- Heinz India Ltd.
- Campco Ltd.
- Bombay Dyeing Ltd.
Thank You