



FOXNUT (MAKHANA) PROCESSING



AATMANIRBHAR BHARAT

**PM Formalisation of Micro Food Processing
Enterprises Scheme (PM FME Scheme)**

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INTRODUCTION

- The Foxnut or commonly name as Makhana (***Euryale ferox Salisb.***) is the seed of an aquatic herb is a monotypic genus of the family Nymphaeaceae.
- Characterized by its hard seed coat (shell), black in colour and round shape with a diameter ranging from about 5 mm to 15 mm.
- It is mainly grown in stagnant fresh water pools of the eastern states of India.
- The nuts are collected from the water and popped to remove edible starchy kernel.
- Due to low fat content, good minerals content, high content of carbohydrates & protein makes it unique.

DISTRIBUTION

- It is considered as native of South-East Asia and China.
- Its distribution is extremely limited to tropical to sub-tropical regions i.e. South-East and East Asia.
- In India it is mainly distributed in the states of Bihar, West Bengal, Manipur, Tripura, Assam, Jammu & Kashmir, Odisha & Other Few States.
- Makhana is commercially produced in few states only.
- In Bihar major Makhana producing districts are Darbhanga, Madhubani, Sitamarhi, Saharsa, Supaul, Araria, Purnea, Kishanganj, and Katihar.
- In West Bengal major Makhana producing districts limited to Malda & Uttar Dinajpur.

VARIETIES AND TYPE OF PRODUCE

- Makhana have mainly grown and cultivated with local varieties from last many years.
- ICAR Research Complex for Eastern Region, Patna (Bihar) has developed first variety of Makhana under the name of Swarna Vaidehi.
- This variety has potential of high yield and resistance to pests-common insects and disease.

VARIETIES AND TYPE OF PRODUCE

Seed Characteristics	
Colour of Seed Coat	Deep Black
Seed Shape	Spherical
Weight for 100 Seed (g)	92-98
Diameter of Seed (mm)	9.5-10.2
Yield Aspects	
Seed/Plant (g)	750-980
Seed/ha (q)	28-30
Quality Characteristics of popped Makhana (Lawa)	
Shape	Oblate
Size	2-2.5 cm
Colour	Sparkly White

CULTIVATION

Makhana is cultivated either in perennial water bodies having water depth of 4-6 feet i.e pond system and in the field system

Comparison of Pond and Field System

Parameter	Pond Eco-System	Field System
Water Requirements	Around 4-6 feet	Around 1 feet
Seed Requirements	80-90 kg/ha	20 kg/ha
Water Source	Natural water as perennial water bodies	Irrigation water or any other perennial source of water
Crop Duration	Long to very long (8-10 months)	Short (4-5 months)
Seed yield	1.8-2.0 t/ha	2.6-3.0 t/ha
Net Income	Low to medium in traditional system	High to very high

HARVESTING

- The scattered seeds at the bottom of the pond or shallow water filled are collected manually during August - October.
- Harvesting of Makhana seeds is done by diving deep inside the water.
- Yield of Makhana varies normally from 1200 to 1500 kg per hectare.
- However in low depth water bodies yield varies from 1800-2200 kg per hectare.



a. Makhana in field cluster



b. Makhana in pond cluster

HARVESTING



c. Makhana Leaves



d. Makhana Flower



e. Makhana Fruit



f. Makhana Harvesting



g. Fresh Makhana Seeds



h. Raw Makhana Seeds

PRODUCTION

- Makhana is considered as an aquatic cash crop in India.
- Bihar in India is the leading state in its production and processing.
- It is estimated that Bihar accounts for more than 80 percent of total Makhana production in the country.
- The total area under Makhana cultivation in India is estimated to be 15000 Ha. It yields 1,20,000 MT of Makhana seeds, which after processing yields 40,000 MT of Makhana Pop.
- The estimated value of the production at farmers end is Rs 250 crore and it generates revenue of Rs 550 crore at trader's level.

MARKET POTENTIAL

- The Makhana sector holds immense potential for value addition, product development and innovation.
- Bolster the economic health of the state & country and bring glory to wonder crop.
- The Makhana market will grow at a Compound Annual Growth Rate (CAGR) of almost 7% during the forecast period of 2019-2023.
- The global Makhana market size will grow by USD 72.5 million during 2019-2023.
- Makhana is highly popular in countries such as India, China, Japan, and Thailand.
- The potential of the Makhana market in Western countries such as the UK and the US is still untapped.

EXPORT OF MAKHANA

Total Value & Volume of Exports

Total Value \$1,388,394

Total Quantity: 292,822

Average Price

Average price per unit: \$4.74

Average value per shipment: \$1,126

Top Supplies

United States: \$751,132

United Kingdom: \$171,480

Canada: \$120,861

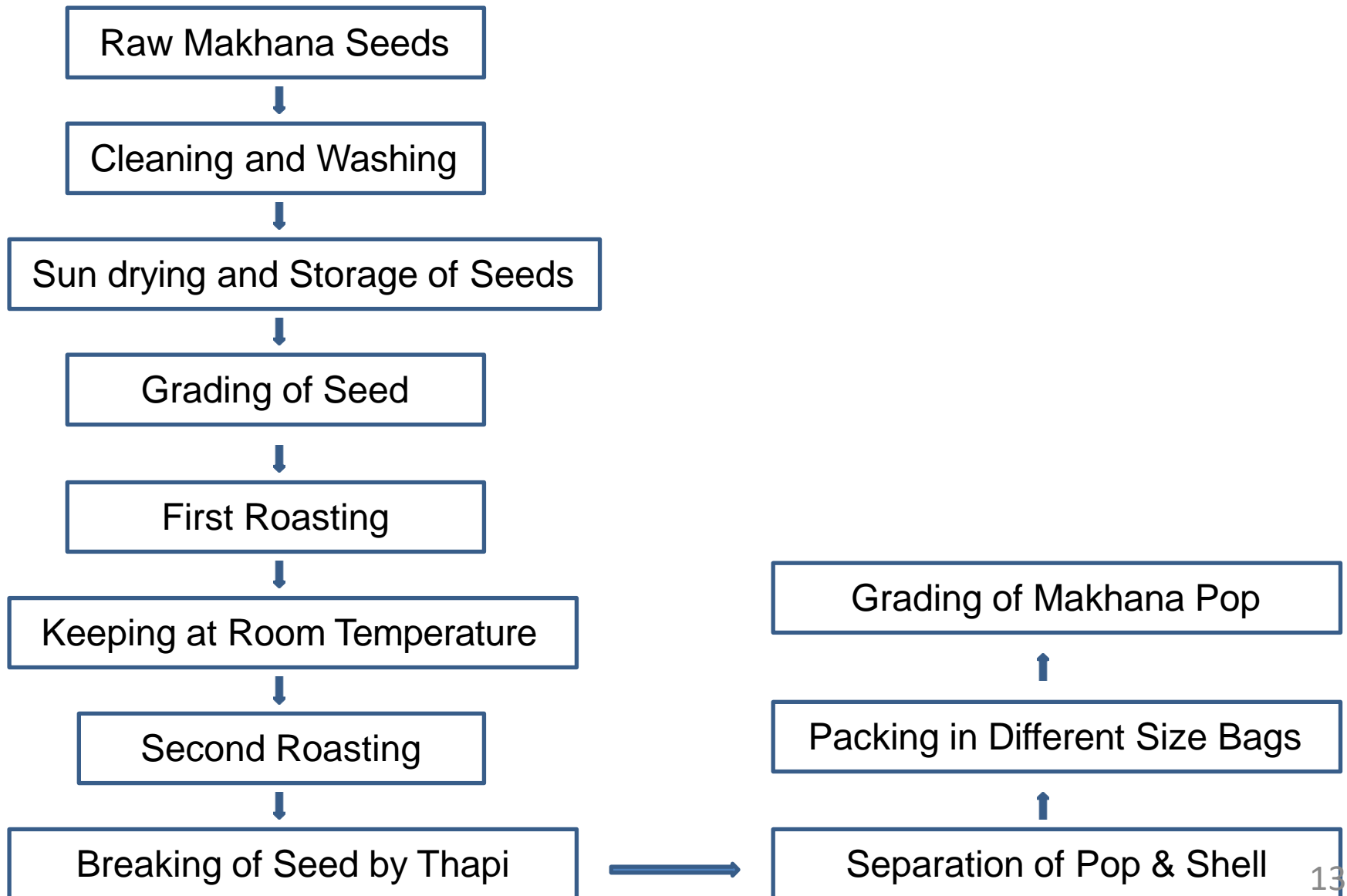
Top Ports of Discharge

Mundra: \$545,155

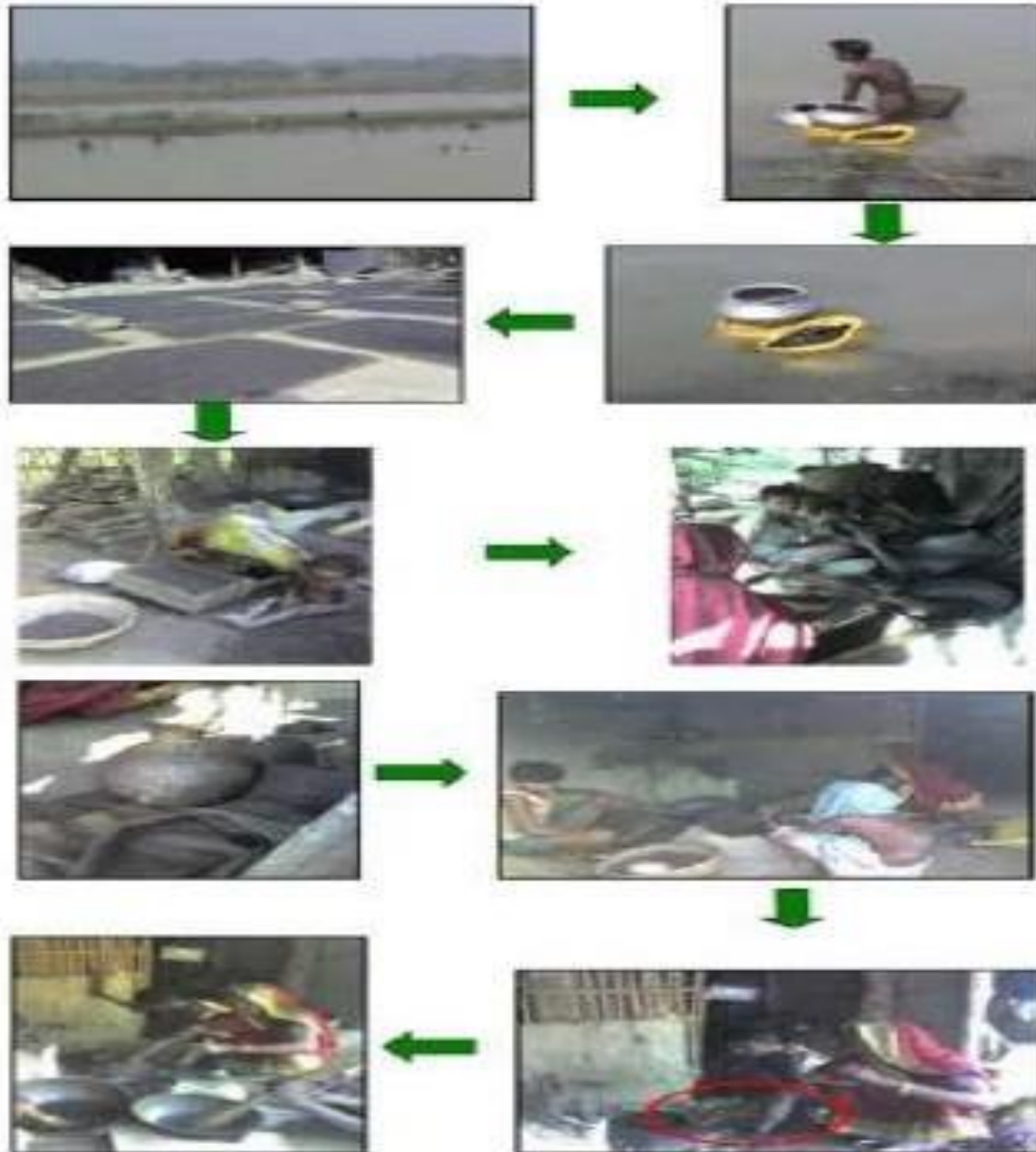
Nhava Sheva Sea: \$475,398

Sabarmati: ICD \$110,582

POST HARVEST OF MAKHANA



POST HARVEST OF MAKHANA



MACHINERIES AND EQUIPMENTS

TRADITIONAL TOOLS AND EQUIPMENTS

Khonngghi or Deli: It is a small bamboo stick bucket with cylindrical shape. It is used for storing raw, popped seed and in polishing operation.

Sieves: Sieves are made of iron sheets with wooden frames. In general seven to ten sieves of different mesh sizes are used for grading of raw Makhana seed.

Mats: Mats are used for sun-drying raw Makhana seeds before roasting.

Iron pan: It is a cooking pan or utensil which is used for pre-heating and roasting of Makhana seeds.

Aphara, Batna and Thaapi: These are wooden appliances made of hardwood, mostly of shisum or mango. Aphara is a platform on which roasted seeds are hit with flat wooden hammer called Thaapi.

Chula's (Earthen Pans): They are utilized for roasting the sun dried seeds or guris without sand mix.

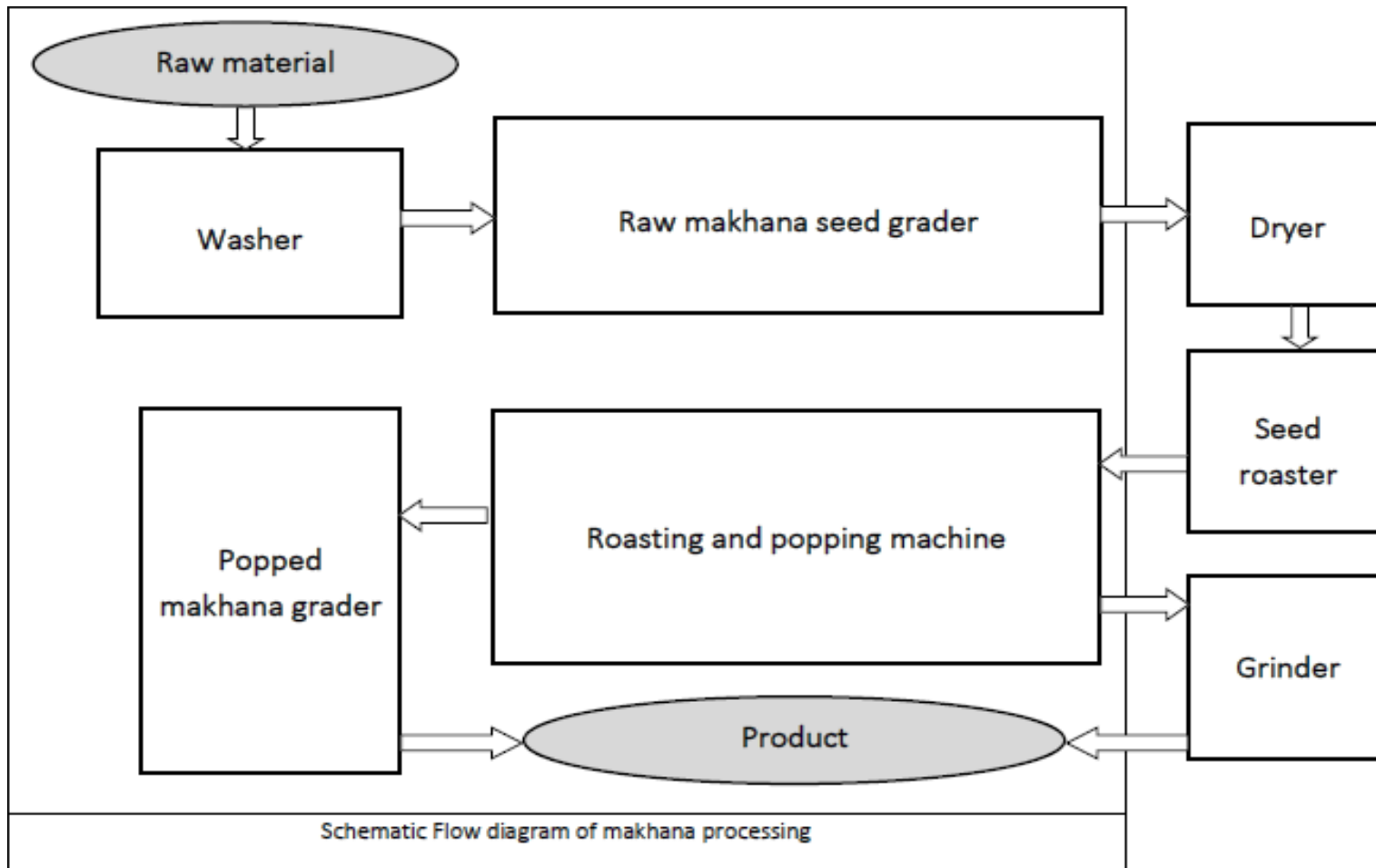
Bamboo Sticks: These are utilized to stir the Makhana seeds while roasting them.

MACHINERIES AND EQUIPMENTS

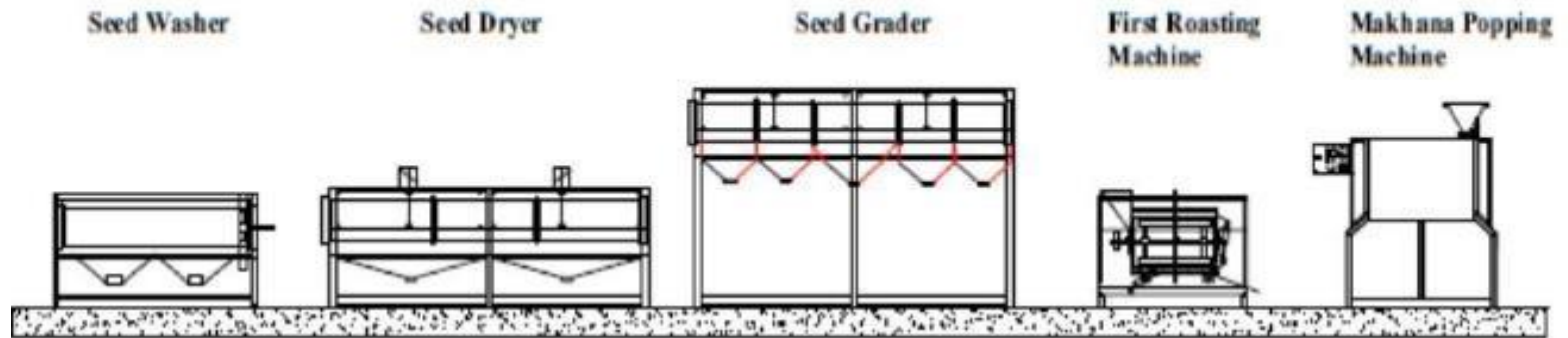
LATEST MACHINERIES AND EQUIPMENTS

1. Raw Makhana Seed Washer
2. Makhana Seed Grader
3. Makhana Seed Dryer
4. Seeds Roasting Machine
5. Roasting and Popping Machine
6. Popped Makhana Grader
7. Un-popped Makhana Grinder
8. Control panel for the Plant

MACHINERIES AND EQUIPMENTS



MACHINERIES AND EQUIPMENTS



Padel Operator Makhana Grader



Makhana Popping Machine

NUTRITIVE VALUE OF MAKHANA

Parameters	Makhana Seed	Popped Makhana
Carbohydrate (% by wt.)	57.0	79.8
Protein (% by wt.)	7.2	8.7
Fat (% by wt.)	0.3	0.5
Moisture (% by wt.)	34.7	10.4
Total Ash (% by wt.)	0.3	0.4
Crude Fiber (% by wt.)	0.5	0.2
Amylose (%)	19.0	18.2
Calorific Value (K.cals/100g)	259	358
Phosphorus (mg/100 g)	66.1	53.2
Potassium (mg/100 g)	35.6	42.0
Iron (mg/100 g)	0.8	1.4
Calcium (mg/100 g)	9.5	18.5
Magnesium (mg/100 g)	11.3	13.9
Sodium (mg/100 g)	48.2	71.0
Copper (mg/100 g)	0.3	0.5
Manganese (mg/100 g)	0.9	1.3
Zinc (mg/100 g)	0.9	1.1

NUTRITIONAL ASPECTS

- Makhana or Fox Nut is a kind of hydrophyte used both as drug and food.
- It exhibits much application and development prospect in the fields of medicine, food and economy.
- The values relating to essential amino acid index (EAAI) and chemical score (CS) of Makhana are close to that to fish.
- The EAAI in raw Makhana and popped Makhana are 93 % and 89 % which are higher than the values for rice (83 %), wheat (65 %), Bengal gram (81.5%), cow's milk (88.8 %), fish (89.2 %) and mutton (87.24 %).

FINISHED AND VALUE ADDED PRODUCT

- It highly relished food consumed as namkeen, snacks, kheer, curry, breakfast cereals and so forth.
- A number of delicious and rich sweet dishes like Makhana kheer, vermicelli, halwa, puddings is very popular.
- The Flour produced from Makhana is used as substitute of Arrow Root and as thickener in different foods preparations.

Few other Value Added Products are:-

1. Popped Makhana
2. Makhana Snacks
3. Instant Makhana Kheer Mix.

FINISHED AND VALUE ADDED PRODUCT

4. Makhana Flour or Powder:
5. Makhana Ready to Eat Breakfast Cereal
6. Makhana Baby Foods or Porridge
7. Makhana Sewwts like burfy and Kalakand
8. Makhana bakery like Bread/Bun & Cookies

BY PRODUCTS

- Makhana processing byproduct is bran+outer coat.
- Makhana Bran may be used as poultry feed ingredients.
- Makhana Outer Coat may be used for fuel purpose.

GRADES OF MAKHANA

- The Quality of the Makhana depends on the size and colour of the lawa.
- Makhana is graded into 2-3 grades namely Lawa or Rasgulla, Murra or Samundha and Thurri.

Comparison of Different Grades of Makhana

S. No	Quality Parameter	Grade 1	Grade 2	Grade 3
1	Size of the Makhana	(Fully Expanded) of diameter $\geq 15\text{mm}$.	Fully Expanded of diameter $\leq 14\text{mm}$	Flattened and Irregular of any diameter
2	Colour of the Makhana	Creamy White	Creamy White with Light Reddish Spot	More Light Reddish Spots
3	Expanded or Irregular	Fully Expanded	Fully Expanded	Flattened and Irregular

QUALITY

- Makhana when properly stored may last more than a year under room temperature and air tight conditions.
- Packages should be kept away from sun, rain and moist conditions in covered premises.
- The Quality parameters of Makhana may be analysed as per the FSSAI Manual of Methods of Analysis for various food products. Few parameters are listed below:-

1. Proximate Compositions

2. Microbiological Analysis

3. Mineral Contents

4. Vitamin Contents

OPPORTUNITY OF MICRO/UNORGANIZED ENTERPRISE

- Government plan for “Vocal for Local” & “Atmanirbhar Bharat” with global outreach vision for enhancing the income of small food business operators & improving health and safety benchmark as a mega development scheme.

The scheme will be implemented under the key areas:-

- FSSAI Registration of all the unregistered and unorganized food business operators (FBO).

OPPORTUNITY OF MICRO/UNORGANIZED ENTERPRISE

- Standardization of the micro food enterprise (MFEs) for technical up-gradation to increase their brand marketing.
- Makhana is also selected as Food Crop for cluster based approach.
- Export promotion with improved health and safety along with integration with retail chain to enhance export market.
- Makhana farmers may be linked to a micro finance institution (MFI), which would provide micro credit through formation of self-help groups, promote health insurance and mitigate risk.



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