

Gorgon fruit or *makhana* its cultivation and processing

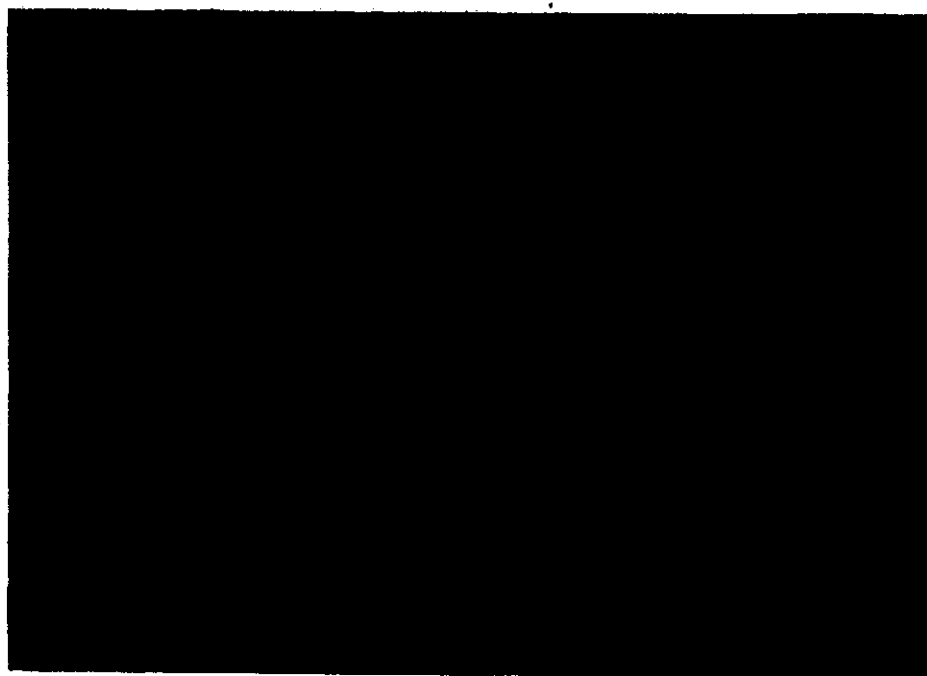
Fried or popped *makhana*, salty or sweet, is widely consumed as snack food. It is rich in carbohydrate, protein and minerals. The popped *makhana* is: moisture 12.8 per cent; protein 9.7 per cent; fat 0.1 per cent; carbohydrate 76.9 per cent; calcium 0.02 per cent; phosphorus 0.9 per cent; iron 0.0014 per cent and other minerals 0.5 per cent.

The perennial crop raised in shallow ponds and lakes supports the livelihood of the fishermen community.

MAKHANA or gorgon fruit or fox nut (*Euryale ferox* Salisb.) is an important aquatic fruit of the family Nymphaeaceae. It is grown in shallow ponds and lakes (1.5-2.5 m deep) in the eastern and north-eastern states of India, Bangladesh and China. In north-Bihar, *makhana* is one of the cash crops that supports the livelihood of the fishermen community.

Makhana plant is characterized by its huge thorny elliptic or orbicular leaves floating on the surface of water like the leaf of lotus. The leaf is sometimes a metre in diameter. Flowers are large, solitary, violet-blue, rose or red usually floating with long pedicles. Fruits are spongy covered with stout prickles. Each fruit contains 20-50 seeds. The seeds measure 5-14.5 mm across. The seeds are collected from ponds and processed into the edible form, *makhana*.

Although the total annual production of *makhana* in India is not known, it is estimated that besides local consumption on an average approximately 150 tonnes of popped *makhana* is despatched annually from Darbhanga alone to other states of India, and partly abroad. From 1963 to 1975, the in-



Huge thorny, elliptic or orbicular leaves of gorgon fruit covering the surface of the pond.

crease in supply from the district has been 110 tonnes to 150 tonnes.

hana cultivation are cleaning of pond, broadcasting of seeds, thinning and gap-filling, plant protection, harvesting and collection of seeds.

CULTIVATION

Makhana is a perennial crop and does not require much investment. The major operations involved in *mak-*

Cleaning of pond
This operation is normally done during September-October each year

be reasonably effective. The growers broadcast 5 per cent BHC dust in case the attack is severe. Diseases of *makhana* are yet to be identified, though no serious damage has been reported so far.

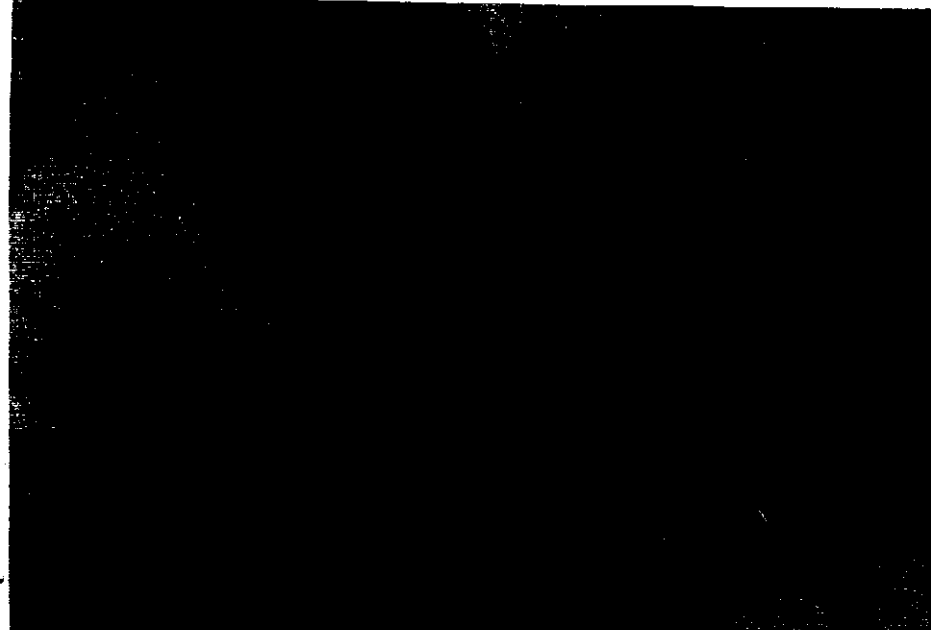
Harvesting and processing

Fruit formation begins during June. On ripening of fruits, the pedicles and petioles along with the leaves start rotting leaving the fruit afloat. After a few days, even the fruits rot and the seeds with their hard seed-coat enveloped in a thin membrane separate to settle at the bottom of the pond.

Farmers begin collecting the seeds in August and continue till November. It is a painstaking job and can only be carried out by experienced fishermen. The entire pond is divided between 5-6 fishermen who collect the seeds from 0.1 ha or so. They crawl under water, sweep the seeds into heaps that are scooped out with the help of a horn-shaped split bamboo contrivance. The seeds collected from the pond are threshed by feet to remove the membranous covering of the seeds. The yield of *makhana* seeds varies from 2.5 to 3.0 tonnes per hectare. Processing of *makhana* seeds is traditionally done at domestic level.

Drying and storage

The cleaned seeds are sundried to nearly 31 per cent moisture content for storage. However, the seeds cannot be stored for long. It is necessary to



Popped gorgon fruit being polished by rubbing against the surface of a basket made of bamboo splits. Polishing is done immediately after popping lest the fruit absorbs moisture.

before the sowing of *makhana* seeds. *Makhana* grows best in perennial ponds with a thick layer mucky at the bottom. Freshly excavated ponds having a hard substratum are not suitable for the purpose. Algal plants must be cleared off from the water. Ponds should not get flooded during the rainy season and there should be 90-120 cm of standing water in the pond even in summer.

Broadcasting of seeds

The ponds under running cultivation of *makhana* have enough left over seeds for the next round of crop. Yet triennial replacement, @ 50 kg/ha of pre-germinated seeds, is advised. In a fresh field, the pre-germinated seed is evenly broadcast in October or November @ 125 kg/ha over the water surface covering the entire pond. The seeds then sink to the bottom and germinate in the mud below.

Thinning and gap-filling

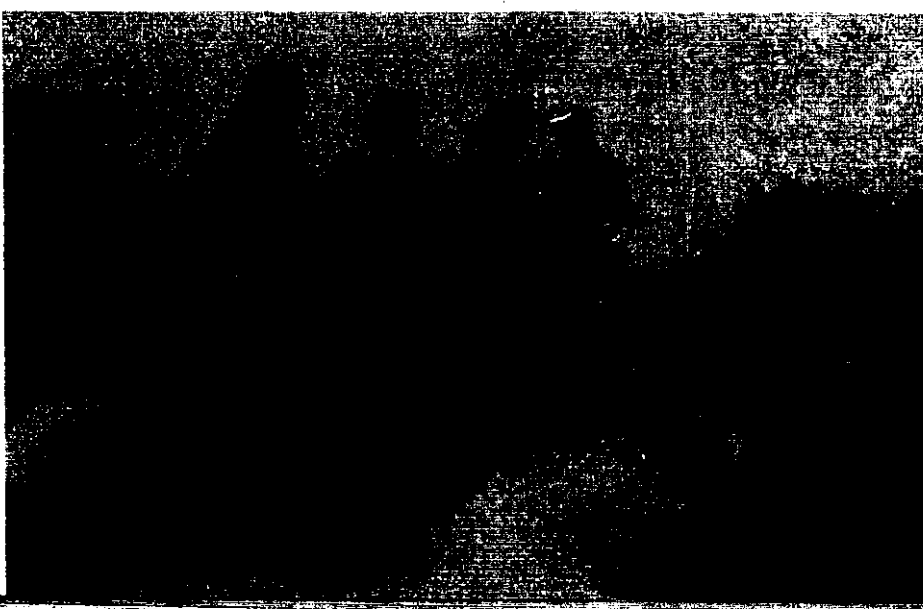
Generally 4 to 5 weedings are done till the pond is completely covered by the broad prickly leaves of *makhana*. For removing weeds, the fishermen stretch a straw rope and move it over the water surface making a heap of weeds, which is thrown out from the pond and left to decay. Thinning out of closely grown plants and their

retransplantation in sparser patches is also practised.

Plant protection

The possible pests infesting the leaves of *makhana* are: the grasshopper (*Hieroglyphus banian*), giant water-bug (*Belostoma indicum*) and aquatic beetles (*Cybister confusus*). Generally infestation is observed in April, May and June, when the entire water surface gets covered with large prickly leaves of *makhana* plants. Since no scientific pest control is known so far, the growers rely on traditional methods. The fishermen stretch a straw rope across the pond holding both ends and move it over the leaves giving a slight patting in order to make the insects fall and sink. The practice has proved to

The seeds of gorgon fruit collected from the pond are trampled upon to remove the membranous covering on them.



sprinkle water at regular intervals during storage to keep them fresh. Popping of the seed is much dependent on initial moisture content. Seeds are often kept under cold water to prevent deterioration. Since, the seed-coat of the *makhana* seed is very thick and hard, pests hardly attack.

Drying and size-grading

Stored seeds are sundried in small batches, bringing their moisture content to 25 per cent. The dried seeds are sieved into 5-7 grades. Grading of seeds facilitates uniform pre-heating and roasting.

Pre-heating and tempering

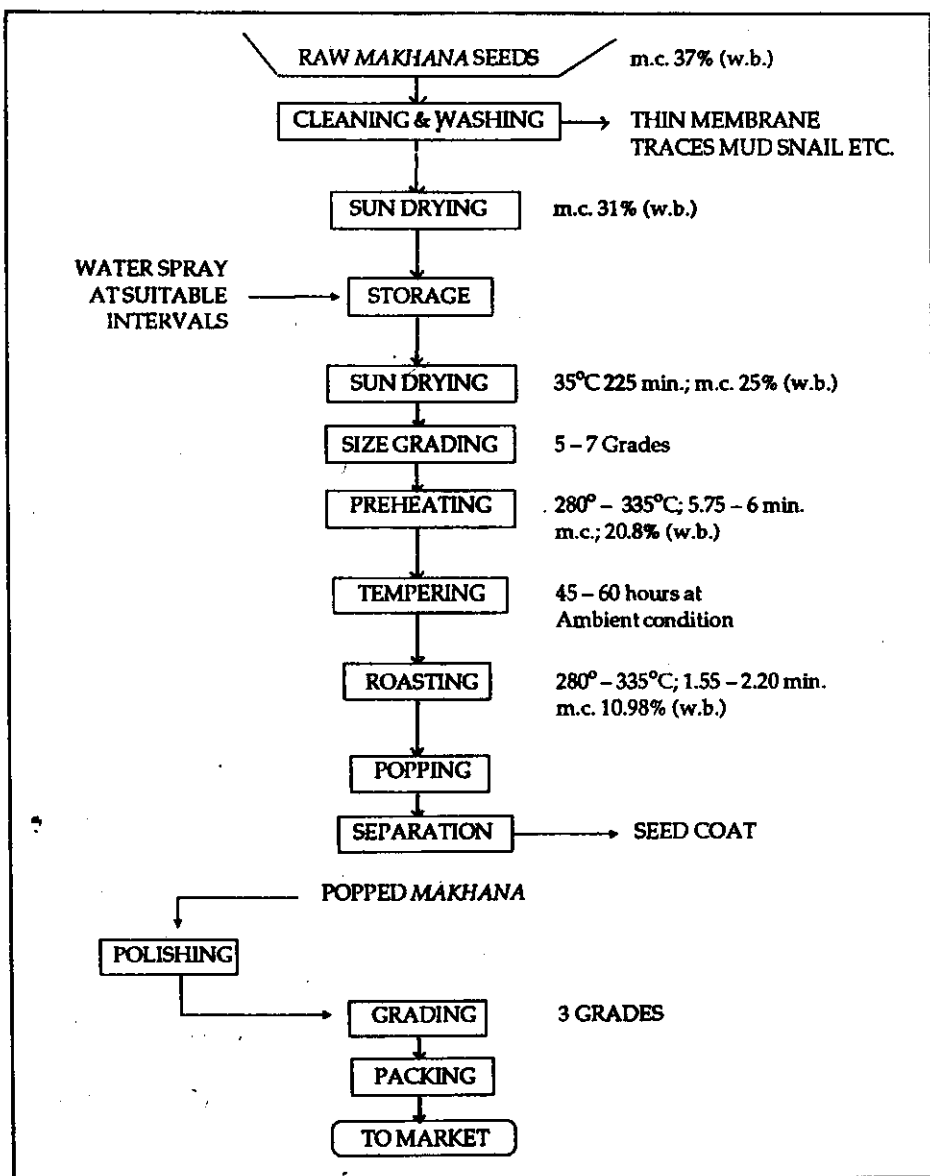
Dried seeds are heated in an earthen pitcher or cast iron pan over fire at 280°-335°C for nearly 6 minutes and stirred continuously. At this stage the moisture content is 20.8 per cent. The seeds are kept in open baskets for 45-60 hr. The process known as tampering facilitates loosening of kernels within the hard seed-coat.

Roasting and popping

About 300 g of conditioned seeds are taken and roasted over fire in an open pan at 280°-335°C and continuously stirred. After 1.5-2.2 minutes there is a crackling noise indicating the level of roasting required. The moisture content of these roasted seeds is about 11 per cent. The hot roasted seeds, 5-7 in number, are scooped from the pan and kept on a hard surface and sudden force applied with the help of a wooden hammer. As soon as the hard seed-coat breaks, the kernel within the seed-coat pops out in expanded form. The seed-coats are separated out manually. The yield of popped *makhana* varies from 35 to 42 per cent on raw-seed-weight basis.

Polishing, grading and packaging

Popped *makhana* are polished by rubbing them on the surface of a basket made of bamboo splits. It is done soon after popping, because the popped *makhana* absorbs moisture



At a glance : How to process the gorgon fruit traditionally ?

very quickly. Popped *makhana* is finally graded into 2 or 3 grades based on size and whiteness. A polyethylene-lined gunny bag with a capacity to store a quintal of sugar may be used to pack 8-9 kg of quality *makhana*.

Makhana is rich in carbohydrate, protein and minerals. The popped *makhana* is: moisture 12.8 per cent; protein 9.7 per cent; fat 0.1 per cent; carbohydrate 76.9 per cent; calcium 0.02 per cent; phosphorus 0.9 per cent; iron 0.0014 per cent and other minerals 0.5 per cent.

Makhana is much used in milk-based food preparations like *kheer* and

puddings. Fried or popped *makhana* with salt or sugar is very widely used as snack food. It is also used for making excellent curry and indigenous tonics.

Makhana also serves as an important source of starch for textile industries.

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