

FISH-AQUATIC PLANTS INTEGRATION

Fish-Aquatic Plants Integration

- Many aquatic bodies are not sufficiently suitable for composite carp culture
- India has vast area of wetlands, derelict water bodies, community ponds and road side ponds
- Such water bodies may be used for propagation of some aquatic plants for fetching of fruits or other edible parts
- In fish-aquatic plants integration, cautious selection of fish species is important

Singhara-An Aquatic Fruit

- Genus *Trapa* comprises about 30 species
- Exclusively grows in eutrophic water
- The nut has two (sometimes four) short slender spines in place of pronounced horns of the Chinese plant
- The fruit with two spines is known as *Trapa bispinosa*
- The four-spined fruit is known as *Trapa quadrispinosa*
- There is also a four spined European species *Trapa natans* commonly known as Jesuit nut or water caltrops or water chesnut

Singhara- An Aquatic Fruit

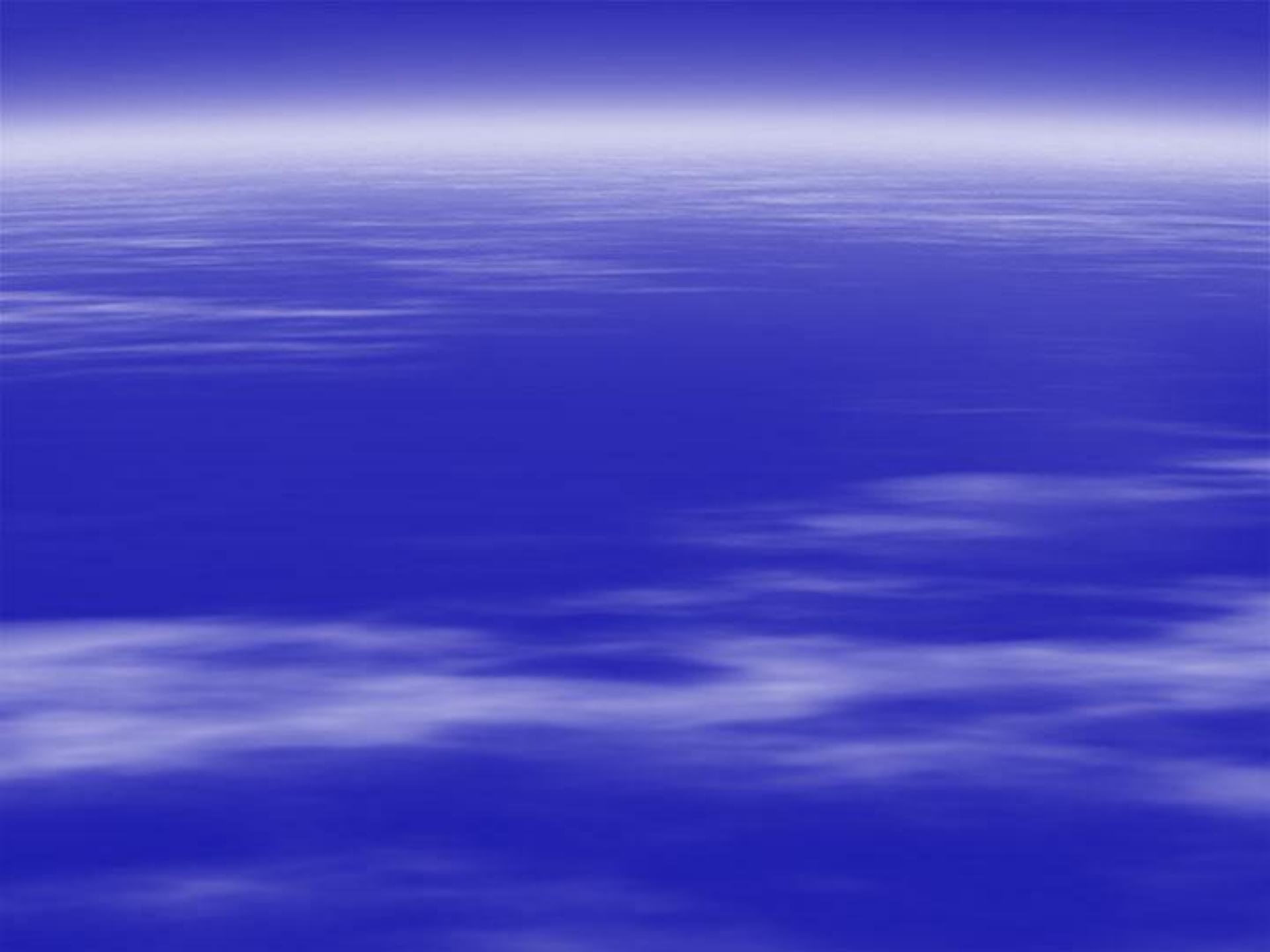
- Called water chestnut in English and Singhara in Urdu
- The Chinese call it 'ling ko'
- Edible sweet fruit
- Good source of calcium, iron, potassium and zinc
- Grown in freshwater ponds, marshes, seasonal and perennial lakes
- Singhara grows best at water depth of 0.5-1.0m
- Plant requires full sunligh and high organic content

Singhara-An Aquatic Fruit

- Water chestnuts are divided into three types
- One that is green, the second that is completely red and the third type is green blended with red
- It is cultivated in tropical countries Asia, Africa and central Europe
- About 2/3 of the water chestnut plants float just beneath the water surface and thus form a thick mat in water column
- *Trapa* has no primary root
- The submerged stem bears two types of adventitious root
- Those near the base of stem fix the plant to muddy substrate
- The rest are free floating fibrous roots born in pairs below the leaf bases and are unusual being green and photosynthetic

Singhara-An Aquatic Fruit

- The flowers are auxilliary, white in colour, with a solitary peduncle
- They open above the surface towards the afternoon
- After pollination, the flowers submerge to facilitate fruit formation
- Fruits appear in September and continue up to January



PROS OF SINGHARA CULTURE

- Water chestnut flour is used as thickener in Asian cooking
- Flour is also used during fasting
- In many parts of Asia, the fruit is a staple food source
- Fruit has been used to treat elephantiasis, rheumatism and skin complaints
- It is an ornamental plant with medicinal and nutritional value

CONS OF SINGHARA CULTURE

- Hard spines are sharp enough to injure people
- It can wipe out native bay grasses from some areas
- Creates breeding grounds for mosquitoes
- Provides only marginal habitat to native fish and birds
- Its complete eradication is very difficult, so waterchestnut has been declared abnoxious weed in many parts of USA

SINGHARA AND INTEGRATED AQUACULTURE

- Singhara cultivation is done in shallower water
- Deep ponds are either utilised exclusively for fish cultivation or at the most the outer peripheral portions with shallow water are used for singhara cultivation
- Such ponds could be put under integrated aquaculture in the form of concurrent singhara-cum-fish cultivation
- Suitable fish species are airbreathing magur, singhi, kawai etc.

PREPARATION OF SEEDLING

- Two methods are used in cultivation:
 1. Natural seeding from previous crops
 2. Preparation and transplanting of seedlings
- While selecting fruits for seeds, spines are cut with sharp knife.
- Selected seeds are stored only after curing with a special technique.
- The seeding material should be kept in large earthen pots which are filled with freshwater and left undisturbed for two to three days

PREPARATION OF SEEDLING

- Water is changed everyday for a week.
- The process is continued until the hard, thick outer skin of the fruit rots and the loose coating of the seed is detached from the fruits and the thin, stony, inner coat becomes visible.
- The curing of seed material is done at room temperature and is completed in about 35-40 days.

PREPARATION OF SEEDLING

- Seeds so cured can easily be stored in the same earthen pot without water and covered with a moist cloth or gunny bag to provide high humidity and low temperature.
- These containers are kept in a cool, shady place and can be stored for up to 3-4 months, without affecting seed viability.

TRASPLANTATION

- Before broadcasting, the seeds are coated with a layer of soil on the opposite face of the germinated portion in order to add extra weight on the non-germinated face and to assure that after broadcasting, in the manner of a shuttle-cock, the seeds will settle at the bottom with the germinated face up and the coated face down.

TRASPLANTATION

- They also can be manually sown.
- The stem starts emerging and gradually spreads out.
- During the months of June-July, seedlings are lifted from the nursery pond and transplanted into larger ponds, ditches, or reservoirs.
- For transplantation, the uprooted stems are cut into several smaller pieces.

TRASPLANTATION

- Lateral shoots commonly known as suckers can be detached from the main mother seed nut for transplanting.
- Single seeded water nuts can develop 20-30 and sometimes even up to 50 such lateral suckers.
- Each of these laterally developed suckers may very well be able to send out 5-10 further shoots after transplanting.
- From sowing to later such formations takes about 40-50 days.
- Shoots also arise from the nodes, forming roots and new plants.

MAKHANA CULTURE

- Makhana, *Euryale ferox*, is perennial aquatic herb
- Water plant with gigantic floating leaves
- Grows in standing shallow water (0.2-2.0 m deep)
- It has a rhizomatous stem deeply rooted in mud by fleshy, thick root clusters
- Leaves are green on upper side and purple red on the lower side
- Leaves are thorny, oval or rounded having a diameter of 0.2-1.0m

DISTRIBUTION

- Extremely limited to tropical and subtropical regions of South-East and East Asia
- Wild populations of *Euryale ferox* are known to exist in Japan, Korea, erstwhile USSR, North America, Nepal, Bangladesh and some parts of India
- In North Bihar about 42% of total water spread area is suitable for makhana growing
- Majority of farmers are cultivating makhana as the mono-crop

DISTRIBUTION

- After harvesting of makhana crop some air-breathing fishes (magur, singhi, kawai, gorai, mud eel) trash fishes and the only crustacean (*Macrobrachium lammeri*) which generally get access and enter through paddy fields into ponds as wild fish are also being harvested by farmers as additional animal crop without introducing seed of these fishes.

MAKHANA CYCLE IN PONDS

- Best grown in perennial ponds with a thick layer of highly nutritive muddy bottom
- Usual time of sowing is Oct-Nov
- 1st time sowing requires 90-100 kg seed/ha while only 35 kg seed/ha is required in ponds which are sown annually
- In new ponds seeds are broadcast on the surface of pond which gradually sink to bottom and finally germinate in muck.
- The germinated seeds sprout in Feb. to March.

MAKHANA CYCLE IN PONDS

- At this time thinning operation is carried out and saplings are transplanted all over the available water space by keeping a gap of about 1 m in between two plants.
- During April-May, the entire water surface gets covered with huge, sprawling, thorny, elliptical leaves which float on surface of water
- Fruits appear in June

MAKHANA CYCLE IN PONDS

- Mature fruits burst around Aug-Sept and the seeds get scattered all over the bottom of pond
- During this period the farmers cut the leaves into pieces and throw for decay
- The scattered seeds at bottom are collected manually during September-October
- Seeds are accumulated in several heaps and collected

ADVANTAGES AND DISADVANTAGES

Advantages

The introduction of fish in makhana ponds may generally benefit both crops

- The most economical utilization of waterbody (pond) may be achieved since the same pond would be used for the production of both *makhana* and fish.

ADVANTAGES AND DISADVANTAGES

- Very little extra labour would be required to look after the fish, since both *makhana* and fish may be taken care of at the same time. This extra labour cost may be compensated for by savings on labour for weeding, since some of the fishes tend to reduce the incidence of weeds.
- The quantity of supplemental fish feeds, if at all given, will be comparatively less than given to the fish in pond culture and unused feed increases the fertility of the pond by acting as organic manure.

ADVANTAGES AND DISADVANTAGES

- Fishes eat harmful organisms like insects and their larvae. *Makhana* yield would increase owing to reduced pressure of insect pests and increased organic fertilization
- *Makhana*- fish culture can also contribute to the control of water borne diseases by feeding on aquatic intermediate hosts, viz. mosquito larvae (malaria) and freshwater molluscs (bilharzia)

ADVANTAGES AND DISADVANTAGES

- The movement of fish would result in better aeration of water and greater tillering of makhana crop
- The excreta of fish will act as additional organic fertilizer

ADVANTAGES AND DISADVANTAGES

Disadvantages

Makhana-cum-fish culture, however, will present certain disadvantages:

- If introduced too early, the fishes may damage the young *makhana* plants.
- Species of fish must be carefully selected to avoid damage to the *makhana* crop

ADVANTAGES AND DISADVANTAGES

- The huge sprawling leaves of *makhana* plant keep the water surface densely shaded from May to August. During this period the grazing chain gets disrupted as sunlight will not penetrate inside the water surface. The dissolved oxygen content of water gets depleted which makes the environment unfavorable for the Indian major and exotic carps.

MAKHANA-FISH INTEGRATION

- Integrating aquaculture with agriculture is an improved system
- Integration is possible only on the intensity of cultural practices involved
- Fish culture in makhana ponds can be grouped as
 - ✓ Secondary crop of fish after makhana
 - ✓ Concurrent culture along with makhana during the period of its cultivation (central vacant space, peripheral vacant space)
 - ✓ Continuous fish culture, transferring the fish to specially prepared ponds or channels during the harvesting period of makhana

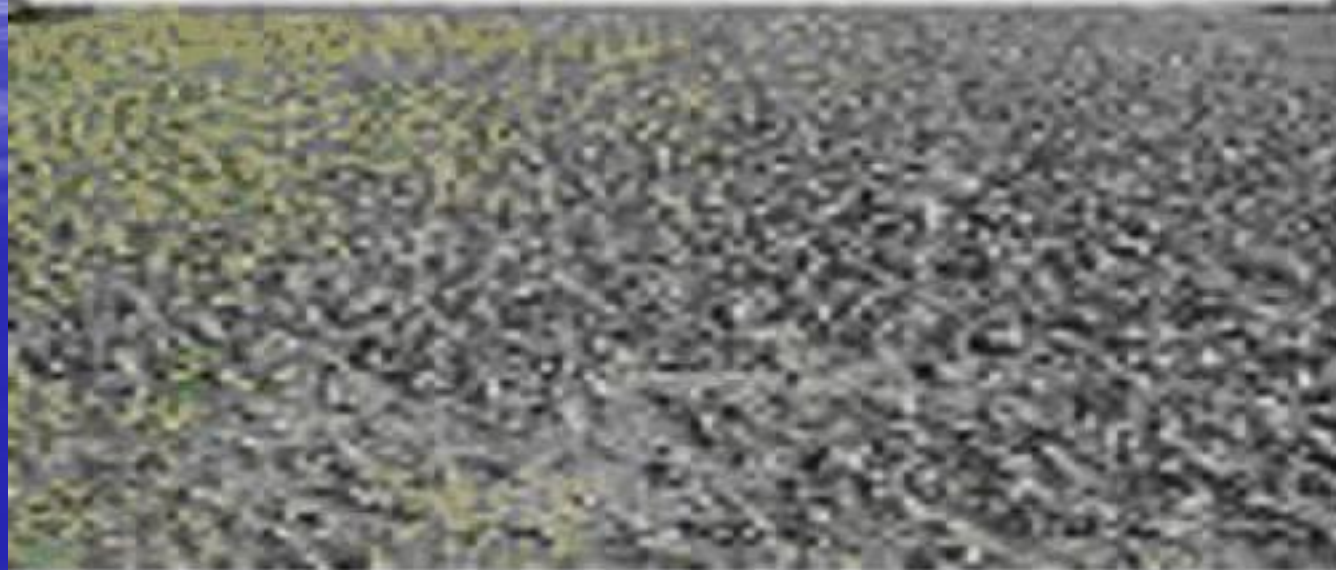


Fig. Singhara Fruits



Fig. Preparation of Singhara Ponds

WATERCHESTNUT IN POND



HARVESTING

SINGHARA





Fig. Singhara Plant

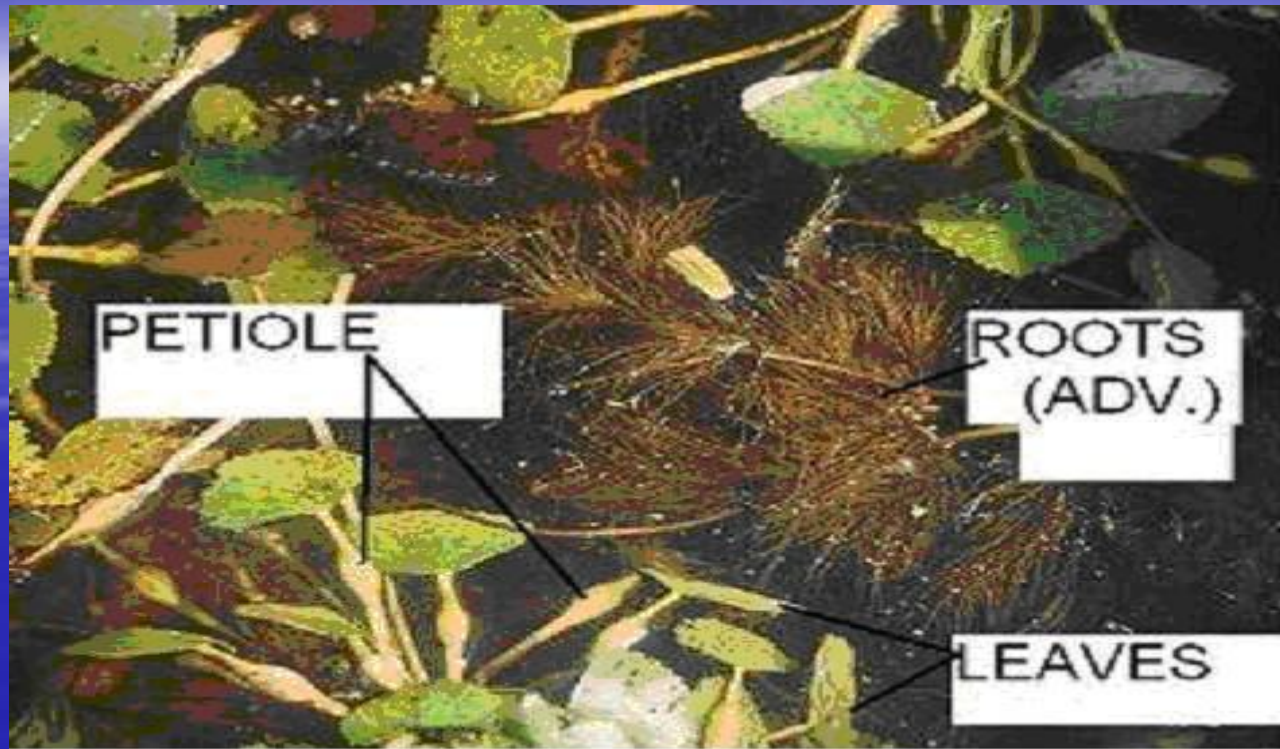






Fig. Makhana Leaf



Fig. Processed Makhana



Fig. Size Grading of Makhana



(a)

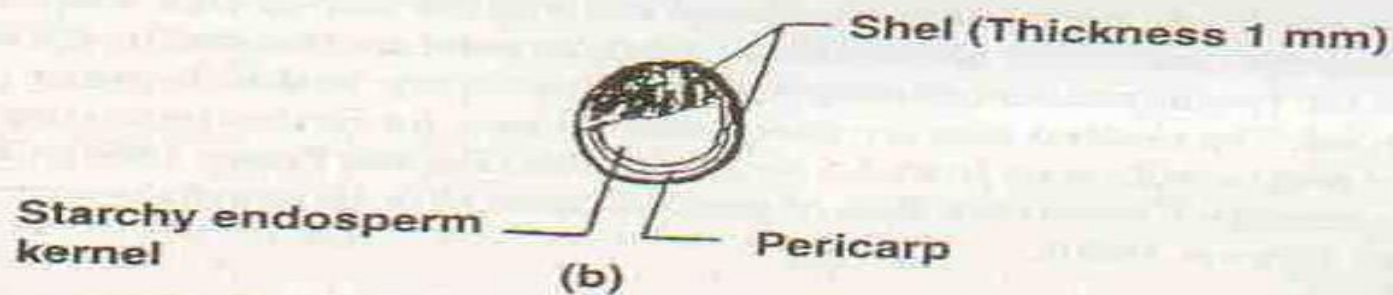


Fig. 26.1. (a) Whole gorgon nuts; (b) Gorgon nut.

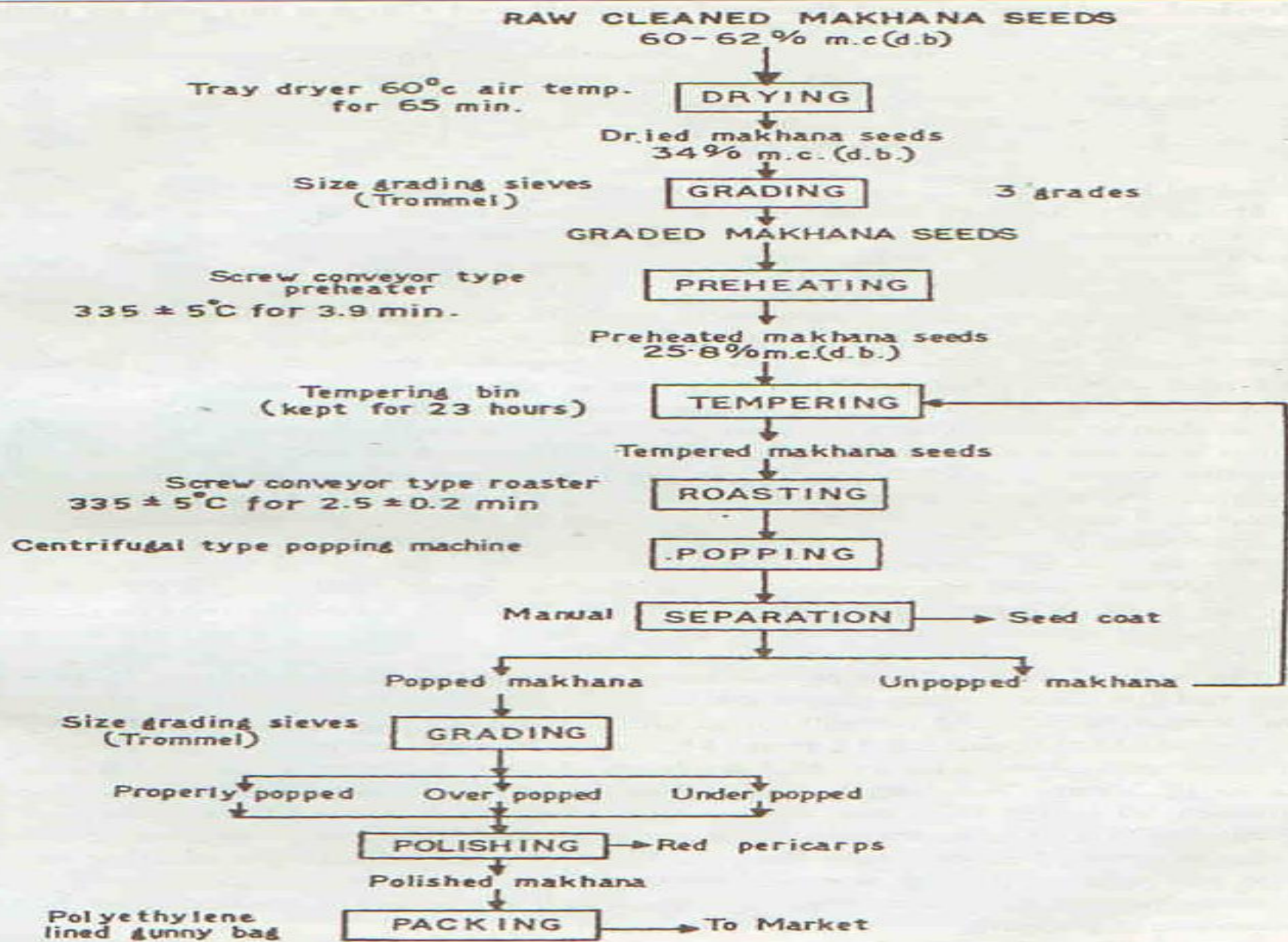


Fig. 26.2-3. Flow diagram of Improved method of gorgon nut processing.