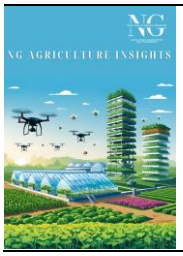

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Pods to Prosperity: Bridging the Post-Harvest Technology Gap in Groundnut

Anisha Dalai[1], Suchismita Tripathy[1]*, Jyoti Rekha Patnaik[1], A. K. Sethy[2], A. C. Dash[1], Dharani Dhar Pradhan[1]

[1]Department of Agronomy, College of Agriculture, OUAT, Bhubaneswar, Odisha
[2]Senior Scientist, AICRP on Groundnut, OUAT, Bhubaneswar, Odisha

*Corresponding author email ID: suchismita.agro@ouat.ac.in

A B S T R A C T

The groundnut, also known as monkey-nut or peanut, is an annual leguminaceous oilseed crop that is grown for the purpose of both seed and oil consumption. It not only provides high quality protein, edible oil and other value added products but also adds nitrogen to the soil via atmospheric nitrogen fixation. Despite all the benefits that it provides, producing a good groundnut crop does not guarantee a good return. Apart from the care till maturity, another equally important journey begins when the crop gets harvested. That is the journey of the pod from soil to the shelf of the consumer. A groundnut crop must be carefully observed to know its mature or not, then harvested, separated from the plant, dried, cleaned, graded, shelled, stored and processed. Any type negligence or mishandling during these operations can lead to reduction in yield, market value, seed quality for consumption. Most importantly, poor postharvest management can lead to aflatoxin contamination, which is one of the greatest quality and food-safety concerns in case of groundnut marketing and consumption. The real challenge, therefore, is no longer simply to produce more groundnut. It is to save more, preserve better and add greater value to what is already produced.

Keywords: Groundnut, Post-harvest technology, Aflatoxin, Value addition, Kernels

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1. INTRODUCTION

Groundnut (*Arachis hypogaea L.*), also known as peanut, is an important leguminous oilseed, food and cash crop. It is consumed as roasted or boiled kernels, groundnut oil, peanut butter, confectionary and snacks. The crop also provides valuable by-products, including oil cake for livestock feed and organic manure, haulms for fodder and pod shells for fuel, briquettes and other industrial uses. In India, groundnut supports farmers, traders, oil mills, food-processing industries and exporters. However, groundnut production is highly vulnerable to quality deterioration during post-harvest management practices. Although negligence during harvesting, delayed harvesting, improper or late drying, mechanical damage, insect infection, rancidity and fungal or bacterial infection can reduce both quantity and quality of the produce. A major concern is aflatoxin contamination caused mainly by *Aspergillus flavus* and related fungi. Aflatoxin is difficult to detect visually in all cases and can create serious food-safety concern, health and export problems. Therefore, post-harvest technology is essential not only for reducing losses but also for ensuring safe, marketable and value-added groundnut products.

2. POST-HARVEST TECHNOLOGIES IN GROUNDNUT

The knowledge, methods, equipment and management practices used after the maturity of crop to harvest and preserve the quality, quantity, safety and market value of agriculture produce till it reaches

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the consumers refers to the post harvest technologies. The main purpose of undertaking these practices and precautions are to reduce the physical loss, prevent mechanical damage, protect against fungal attack and aflatoxin contamination, minimize quality deterioration, extend shelf life, improve market price and convert raw groundnut into safe and profitable products.

Figure 1. Steps of postharvest technology chain in groundnut

2.1. Harvesting at the correct maturity:

Harvesting at right time is necessary as the immature pods will have poorly developed kernel, low shelling percentage and inferior flavour and the over matured pods may germinate in the field or the pods may detach from the plant and remain in the soil during harvest. Therefore, the crop should be examined for pod development regularly and to be harvested when a substantial portion of pods have reached physiological maturity. Cuts, bruises or any cracks during harvesting increase the chance of insect and fungal infection, so harvesting should be done carefully. Harvesting in traditional methods include manual pulling, hoes and animal-drawn implements where as mechanised systems now include manual and animal-drawn diggers, power-tiller-operated diggers, tractor-operated digger-lifters, digger-shaker-windrowers, large-scale integrated harvesting systems. The mechanised systems can reduce drudgery and improve the speed of harvesting but their efficiency depends heavily on soil moisture, crop type and proper row adjustment.

2.2. Uprooting and Curing

The plants are commonly inverted after uprooting, to let the pods remain exposed while the foliages resting on the soil surface. This inverted drying method improves aeration and allows the pods to dry more rapidly. Curing involves holding the uprooted plants for a short period to allow moisture movement from the plant and pods. In traditional systems, plants may be arranged in small heaps or windrows. The plants should not be left in wet soil or exposed to repeated rainfall because high moisture can lead to fungal development.

2.3. Drying Technologies

Drying is one of the most important operations in post-harvest management of groundnut. The

objective is to reduce moisture to a level that limits fungal growth, insect activity, respiration and rancidity. Sun drying remains highly dependent on weather. Rainfall, high humidity and rewetting can delay drying and increase the risk of deterioration. On the other hand, conventional mechanical dryers may be too costly or energy-intensive for small farmers. Traditional drying usually depends on- field curing, windrow drying, sun drying, drying plants with pods attached. Modern technologies include- natural-air drying, hot-air drying, solar-assisted drying, infrared drying, radio-frequency and other advanced drying systems.

2.4. Stripping and Threshing

The process of removing pods from the harvested plants is known as stripping. It can be performed manually, by beating plants against a surface or by using mechanical strippers and threshers. Manual stripping is labour-intensive and can result in pods being left on the haulms whereas mechanical stripping reduces labour requirements and improves timeliness. However, machines must be correctly adjusted to prevent pod breakage and kernel damage.

2.5. Cleaning and Pre-cleaning

Cleaning of pods is done to remove soil, stones, leaves, stems, immature pods, insect-damaged material and other foreign matters. It can be performed using sieves, winnowers, aspirators, rotary cleaners, vibratory screens and air-screen cleaners. Pre-cleaning before storage is essential because mouldy, discoloured, shrivelled and insect-damaged pods can become sources of contamination.

2.6. Shelling or Decortication

Shelling, also known as decortication, is the process of removal of the pod shell from the kernel. It can be performed manually or mechanically. Mechanical decorticators generally use impact, shear, compression or a combination of these forces. Their performance depends on- pod moisture, variety and pod size, machine speed, feed rate, screen size and adjustment of concave clearance. Shelling should be carried out only after adequate drying. Over-dried pods may produce broken kernels, while wet pods may shell poorly and increase microbial risk.

2.7. Grading and Size Separation

The process of separating the pods or kernels according to size, weight, colour, shape, shelling percentage and end use is known as grading. Groundnut grades may include bold, medium and small kernels. Grading is important because different industries require different kernel sizes. Such as-

- Large kernels are preferred for table use and confectionery.
- Medium kernels are used for roasting, salted products and snacks.
- Small or damaged kernels may be directed toward oil extraction, provided they are safe and free from aflatoxin.
- Uniform kernels are preferred for export, peanut butter and premium food products.

2.8. Sorting and Aflatoxin Management

Sorting is a critical food-safety technology. It involves removing- mouldy kernels, discoloured kernels, insect-damaged kernels, shrivelled kernels, rancid or damaged kernels and foreign materials. Sorting can be done manually or with mechanical, optical, camera-based and laser-based systems. Advanced colour sorters can identify kernels with differences in colour and appearance that may be associated with fungal damage. However, sorting is not a substitute for good drying and storage. Aflatoxin may be present without obvious external symptoms, and contaminated kernels cannot always be identified by appearance alone. Prevention through timely harvest, rapid drying, clean handling and moisture control is therefore more reliable than depending only on final sorting.

2.9. Moisture Measurement and Quality Testing

Moisture meters provide a rapid and more reliable alternative for estimating moisture by hand. Regular testing supports fair pricing and helps prevent the mixing of safe and unsafe lots. It also enables traceability from farmer to processor. They can be used by farmers, traders, cooperatives, warehouses and processing units. Important quality parameters include-

- Pod and kernel moisture
- Shelling percentage
- Kernel count
- Oil content
- Broken kernels
- Foreign matter
- Insect damage
- Mould contamination
- Aflatoxin level
- Free fatty acid content
- Peroxide value
- Germination percentage of seed lots

2.10. Packaging

Packaging protects groundnut from moisture absorption, insects, rodents, dust, odours and mechanical damage. For long-term storage, the packaging material must provide protection without trapping excessive moisture. Packaging for processed products should also limit oxygen and moisture entry. Nitrogen flushing, vacuum packaging and oxygen absorbers can help extend the shelf life of roasted kernels and other high-value products. Common packaging materials include- jute or gunny bags, polyethylene-lined gunny bags, high-density polyethylene bags, woven polypropylene bags, hermetic storage bags, bulk containers and food-grade plastic packaging.

2.11. Storage Technologies

Groundnut should be stored in cool, dry, clean and well-ventilated structures. Important storage practices include:

- Drying pods or kernels to a safe moisture level
- Using clean and disinfected storage rooms
- Stacking bags on wooden or plastic pallets
- Keeping bags away from walls and floors
- Preventing roof leakage and seepage
- Controlling insects and rodents
- Inspecting lots regularly
- Avoiding the mixing of lots with different moisture levels
- Maintaining records of variety, date, moisture and source

2.12. Roasting and Blanching

Roasting improves flavour, aroma, texture and consumer acceptability. Roasting temperature and time must be standardized because under-roasting produces poor flavour, while excessive roasting causes scorching, bitterness and loss of nutritional quality. It may be performed using- pan roasting, drum roasting, sand roasting, hot-air roasting, fluidized-bed roasting and continuous belt roasting. Blanching removes the testa or skin from kernels. It may be carried out by dry blanching, water blanching or mechanical rubbing after heating. Blanching is useful in the production of peanut butter, confectionery products and some bakery products.

2.13. Value Addition and Processing

Groundnut can be processed into a wide range of products, including:

- Roasted and salted kernels
- Boiled groundnut
- Peanut butter
- Groundnut chikki and nut bars
- Groundnut laddu
- Flavoured and coated peanuts
- Peanut flour
- Defatted peanut flour
- Groundnut milk and beverages
- Groundnut oil
- Oil cake and protein-rich meal
- Confectionery fillings
- Bakery ingredients
- Protein supplements

3. GAPS BETWEEN TECHNOLOGY AND ADOPTION

- High initial cost of machineries
- Fragmented production lands
- Seasonal labour and timeliness
- Limited awareness
- Inadequate drying and storage infrastructure
- Poor access to testing
- Lack of repair and maintenance services
- Weak linkage between quality and price
- Limited credit and collective ownership
- Gender and drudgery concerns
- Inadequate training
- Weak value-chain coordination

4. THE WAY FORWARD

- Promoting a complete post-harvest package
- Establishing village level custom hiring centres
- Developing low-cost, locally adapted equipment
- Improving drying infrastructure
- Linking quality to premium pricing
- Strengthening farmer organizations
- Expanding training and demonstrations
- Strengthening aflatoxin surveillance
- Encouraging local value addition
- Using digital traceability and market information
- Integrating sustainability

5. CONCLUSION

In groundnut, post-harvest technology is crucial to the productivity, profitability and safety of groundnut production. It starts with determination of maturity and continues through curing, drying, cleaning, grading, sorting, storage, processing, packaging and marketing. The most important parts include rapid and adequate drying, preventing any

external damage to the pod, removing debris and defective materials, safe storage and aflatoxin control. Machineries like mechanical strippers, moisture meters, dryers and sorting machines can improve post-harvesting methods but their success depends on the capacity of farmer to afford them and skill to operate them. The way forward is to promote integrated, locally adapted and value-chain-oriented solutions rather than isolated machines. Village-level custom hiring centres, farmer organizations, quality-based pricing, improved testing facilities, practical training and small-scale processing enterprises can help close the gap between available technology and actual adoption. With these measures, groundnut can move from a largely raw commodity to a safer, more profitable and more diversified food and industrial product.

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