Traditional storage practices of spices and condiments in Odisha

Naresh Babu*, S K Srivastava & Suman Agarwal
Directorate of Research on Women in Agriculture, Bhubaneswar- 751 003
E- mail: nareshhort@yahoo.co.in

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Spices and condiments are important cash crops in Odisha. About 2.17 lakh tonnes spices are being produced annually from 2.37 lakh ha area. However, storage losses of spices are very high (30 - 40%) due to inappropriate storage practices. Therefore, the present study was carried out during 2009- 2010 to assess the current status of the traditional practices followed by farmers in general and women in particular for storage of spices and condiments in Odisha for ginger (Zingiber officinale Rosc.), turmeric (Curcuma longa L.), chilli (Capsicum annuum L.), onion (Allium cepa L.), garlic (Allium sativum L.) and coriander (Coriandrum sativum L.). Four districts of Odisha namely Khurda, Ganjam, Kandhamal and Keonjhar were selected where these spices are cultivated and stored by the farmers. The sample consisted of 360 farmers including 180 women. Observations revealed that a large number of farmers still practice the traditional storage system. Ginger and turmeric are stored in pit method, heap method and in situ method while chilli, onion and garlic are stored in a mesh bags and hanging method. In traditional method of storage, farmers are depending on local resources and practices. Spices are stored by the farmers of Odisha mainly for home consumption, seed purpose and for income generation. Storage losses were recorded 10 - 15% in ginger, 20 - 30% in turmeric, 10 - 15% in onion and garlic in traditional method of storage which were less as compared to who has not adopted storage practices.

Keywords: Spices, Traditional storage practices, Post harvest losses, Indigenous methods, Domestic demand and pungency

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Spices and condiments are indispensable components of Indian diets. They are used as condiments and seasonings for food preparations as they add flavour, taste and colour. Spices have good anti-oxidant and preservative properties as well as anti-microbial and antibiotic properties, and therefore, are also used for medicinal purposes. Some of the spices are rich in iron, vitamins, trace metals and potassium. Spices have a global demand and they can earn valuable foreign exchange. India is known as the “Home of Spices” and produces a large variety of spices. About 60 varieties of spices such as pepper, cardamom, chillies, ginger, turmeric, coriander, cumin, etc are grown in the country. India exports only a small quantity of spices (6-7% of the total produce) to 130 countries in the world. The rest is consumed in the Indian market, as there is an immense domestic demand. Currently, India is one of the major producers of ginger and turmeric in the world besides other spices. Our country presently produces around 4.1 million tonnes annually from 2.6 million hectare land. In 2009- 2010 the export of spices from India has been 502750 tonnes valued Rs. 5560 crores. Though every state/ union territory of the country grows at least a few spice crops, Kerala, Andhra Pradesh, Odisha, Gujarat, Maharasta, West Bengal, Karnataka, Tamil Nadu and Madhya Pradesh are the major states in spice production. Odisha grows several spices like chillies, ginger, turmeric, coriander, garlic in the area of 2.37 lakh ha with a production of 2.17 lakh tonnes. Turmeric and ginger are two most important spice crops grown in Odisha and more than 50% of these crop growers are tribals. Turmeric is a cash crop grown by Kondha tribes of Kandhamal district and Langi Kondh of Gajapati district. The crop is grown by the tribals with their indigenous methods. Local, Lakadong and Suroma varieties of turmeric are grown by farmers in Kandhamal of Odisha. Ginger is another important spice crop of the state mostly grown by the tribals in some specific agro climatic zones. The crop is mostly produced organically and the farmers get a good return out of this crop. In view of the potential of ginger and turmeric, the state proposed for the Agri Export Zone (AEZ). The zone covers the district of Kandhamal. Chilli is also a major crop grown in the...
southern coastal region of the state. Losses of spice was high (30 - 40%) due to high moisture content (55 - 85%) at the time of harvest and poor storage method. Moreover, changes in quality of spices during storage are the most serious limitations of shelf life of the product, which in turn affects the consumer acceptance. Till today, there are hardly any cold storage facilities available in the state. Only few processing units exist but are not functioning up to the desired capacity. Marketing of ginger in the state is major problem due to non – topping of value added products like oleoresin, volatile oils, etc. Storage of spices is the responsibility of the farmers including women who use different methods, products, and containers to store it for different purposes. Storage of spices is necessary to prevent losses, increase usability and enhance income. The practice for storage of spices dates back to the very earliest periods of known human history. The logic behind the use of these practices and storage methods is that they are user-friendly and suitable for resource poor farmers. Such practices are generally based on locally accessible and available natural resources. Information on traditional spices storage practices in Odisha is not well documented so far. Therefore, an effort was made to assess the current status of the traditional practices followed by farmers in general and women in particular for storage of spices and condiments in Odisha so that Indigenous Technical Knowledge (ITKs) for storage practices of spices can be documented and popularized among end users to minimize the post harvest losses.

Methodology
The study was undertaken in four districts of Odisha such as Khurda, Ganjam, Kandhamal and Keonjhar during 2009 and 2010. From each district, 3 villages were selected where these spices were cultivated and stored by the producers. From each village 30 farmers including 15 women were selected randomly. The samples consisted of 90 farmers including 45 women from each district and in total 360 farmers including 180 women were selected. The information was collected through group discussion with the help of well structured schedules to elicit the information on the purpose and method of storage, quantity of storage, type of containers, materials used for storage (Figs. 1-7). Information was collected on the basis of personal interview to each of the farmers through a questionnaire.

Results and discussion
Ginger (Zingiber officinale Rosc.)
There are 3 traditional storage methods for ginger rhizome in Odisha. They are storage in soil pits, storage in a dry and shaded place and in situ storage. By in situ storage (delayed harvest), farmers harvest the rhizomes according to market demand and allow the rest of rhizomes remain in the field for household consumption. This method is prone for rhizome rot, rhizomes starts sprouting in course of time and harbour insect pests. In pit storage, either a circular or rectangular pit (1-2 m depth) is dug under shade. A thin layer of paddy straw is spread over the bottom of pit and rhizomes are placed into this in layers just below ground level. Again a thin layer of straw covers the rhizomes. The final covering is done with the soil little above the ground level. The pits are opened at the time of next sowing season. In this method, the rhizomes were spoiled in two ways, i.e. 25 – 40% rhizome rot in the pit itself and about 10 – 20% rhizomes sprout in the pit and the same unfit for sowing. Pit storage method is the best for small scale farmers. This storage method is adopted by farmers for seed purpose. For seed material, bold and healthy rhizomes from disease free plants are selected immediately after harvest. For this purpose, healthy and disease free clumps are marked in the field when the crop is 6 - 8 months old and still green. Storage in dry shaded places is economic for the larger growers but there is a problem of rhizome drying. To reduce the spoilage of ginger during storage, healthy ginger rhizomes are selected at the time of harvesting. Selected rhizomes are cleaned, dried in shade and kept in a pit dug in a cool place with the protection from sunshine and rains. A pit of 1 m depth is made and a layer of sand is put 2 cm thick at the bottom of pit. Ginger rhizomes are kept over the sand inside the pit. The pit is covered with wooden planks having some space between rhizomes and wooden planks and coated with cow dung paste. Generally pasting of cow dung in pits is done by women. Farmers separated shriveled and disease affected seed rhizomes in pits once in 20 - 25 days intervals. Extraction of shriveled and disease affected rhizomes is done by men and women. By this process, ginger rhizomes could be stored for 4 - 5 months with 10 - 15% losses. Some of the farmers in Ganjam and Khurda districts used dried leaves of Strychnos nux-vomica L. for storage of ginger rhizomes as Strychnos nux- vomica L. is found effective for control of rhizome scale.
Turmeric (*Curcuma longa* L.)

Due to lack of rural turmeric milling industry and storage facilities farmers are forced to sell their produce to money lenders under distress conditions. Rhizomes of turmeric are stored by farmers of Odisha mainly for 3 purposes, i.e. for home consumption, seed purpose (used for sowing in next season crop) and for sell. It has been observed that mostly tribal families consumed turmeric rhizomes in place of turmeric powder and stored for home consumption. Study revealed that after harvesting turmeric rhizomes, grading and cleaning are done by the women. Rhizomes of turmeric are boiled in aluminum pots with 20 kg capacity along with ¾ water for 45 - 60 minutes, depending on the quantity. The pots are covered with a lid. Boiling process is continued till white froth appear with a special quality flavor. Cooking process is completed when rhizomes become soft and inner colour turns yellow. Boiled turmeric is usually sun dried for 10 - 15 days and kept away from light and in a very dry environment. This method of processing is done by tribals *Kondha*. Rhizomes of turmeric for seed purpose are generally stored after heaping under the shade of a tree or in well ventilated room/shed (Fig. 1) and covered with turmeric leaves. Generally this storage method is adopted by small scale farmers. Sometimes, the heap is plastered with earth mixed with fresh cowdung. The seed rhizomes can also be stored in pits with saw dust and sand along with leaves of *Strychnos nux-vomica* L. (*kanjiram*). The pits are to be covered with wooden planks with one or two openings for aeration. It has been noticed that rhizomes are treated with bavistin fungicide @ 2gm/L of water solution for 15 minutes before storage to avoid diseases during storage. This storage method is adopted by progressive farmers. As per feedback given by farmers 540 - 600 cm deep, pits are best for storage of turmeric. Raw turmeric sold by farmers is stored in these underground pits for 3-4 yrs. These pits provide the best storage facility for turmeric as the quality of the commodity remains unchanged. This storage system has an added advantage in that the turmeric hardens and matures while in storage. Storage of seed rhizomes in open sand media with partially closed pandal system recorded the highest percentage of germination (95%) and less weight loss (4.2%). Turmeric is generally stored in air-tight underground pits lined and covered by *rellu* grass (*Saccharum spontaneum* L.) or date mats, before the onset of monsoon and the pits are opened after the rains. In Odisha, turmeric is also stored in ordinary godowns. It is reported that due to the high oil content of turmeric produced in Odisha, storage in ordinary godowns does not pose any problem with pests. Moreover, turmeric is also stored in the raw state. Some amount of the produce is stored in godowns of State and Central Warehousing Corporations. Prophylactic measures including fumigation are followed to protect the produce from storage losses. In Kandhamal district, farmers stored turmeric in the field and also in backyard under the shade of mango (*Mangifera indica* L.) and jackfruit (*Artocarpus heterophyllus* Lamb.) trees (Fig. 2). As tree protect rhizomes from sunshine and rains and also create micro environment to reduce the losses. For that purpose pits are dug about 1 m size and place the rhizomes of turmeric 40 - 80 kg and covered by sal (*Shorea robusta* Gaertner f.) and turmeric (*Curcuma longa* Linn) leaves. Sal is shedding most of the leaves in between February to April. Tribal farmers in Kandhamal district reported that sal and turmeric leaves were found effective for control of termites. Sal and turmeric leaves are collected by women. As women are the ones who have traditionally been collected these products5. Farmers reported that about 20 - 30% rhizomes are spoiled during storage period.

Chilli (*Capsicum annuum* L.)

Chillies are perishable having 70 -80% moisture content at the time of harvest but for safe storage the moisture should be 10%. It has been observed that women checked this moisture content by breaking of chilli into pieces before storage. Fruits are harvested at ripe stage, heaped for 24 hrs and then dried in the sun for about one week until they are soft and wrinkled. Women are using local basket for drying chilli and some places women are drying chillies on outdoor concrete floor (Fig. 7). Fruits turned at ripe stage, heaped for 24 hrs and then dried in the sun for about one week until they are soft and wrinkled. Women are using local basket for drying chilli and some places women are drying chillies on outdoor concrete floor (Fig. 7). Fruits turned at ripe stage, heaped for 24 hrs and then dried in the sun for about one week until they are soft and wrinkled. Women are using local basket for drying chilli and some places women are drying chillies on outdoor concrete floor (Fig. 7). Fruits turned at ripe stage, heaped for 24 hrs and then dried in the sun for about one week until they are soft and wrinkled. Women are using local basket for drying chilli and some places women are drying chillies on outdoor concrete floor (Fig. 7). Fruits turned at ripe stage, heaped for 24 hrs and then dried in the sun for about one week until they are soft and wrinkled. Women are using local basket for drying chilli and some places women are drying chillies on outdoor concrete floor (Fig. 7). Fruits turned at ripe stage, heaped for 24 hrs and then dried in the sun for about one week until they are soft and wrinkled. Women are using local basket for drying chilli and some places women are drying chillies on outdoor concrete floor (Fig. 7). Fruits turned at ripe stage, heaped for 24 hrs and then dried in the sun for about one week until they are soft and wrinkled. Women are using local basket for drying chilli and some places women are drying chillies on outdoor concrete floor (Fig. 7). Fruits turned at ripe stage, heaped for 24 hrs and then dried in the sun for about one week until they are soft and wrinkled. Women are using local basket for drying chilli and some places women are drying chillies on outdoor concrete floor (Fig. 7). Fruits turned at ripe stage, heaped for 24 hrs and then dried in the sun for about one week until they are soft and wrinkled. Women are using local basket for drying chilli and some places women are drying chillies on outdoor concrete floor (Fig. 7). Fruits turned at ripe stage, heaped for 24 hrs and then dried in the sun for about one week until they are soft and wrinkled. Women are using local basket for drying chilli and some places women are drying chillies on outdoor concrete floor (Fig. 7). Fruits turned at ripe stage, heaped for 24 hrs and then dried in the sun for about one week until they are soft and wrinkled. Women are using local basket for drying chilli and some places women are drying chillies on outdoor concrete floor (Fig. 7). Fruits turned at ripe stage, heaped for 24 hrs and then dried in the sun for about one week until they are soft and wrinkled. Women are using local basket for drying chilli and some places women are drying chillies on outdoor concrete floor (Fig. 7). Fruits turned at ripe stage, heaped for 24 hrs and then dried in the sun for about one week until they are soft and wrinkled. Women are using local basket for drying chilli and some places women are drying chillies on outdoor concrete floor (Fig. 7). Fruits turned at ripe stage, heaped for 24 hrs and then dried in the sun for about one week until they are soft and wrinkled. Women are using local basket for drying chilli and some places women are drying chillies on outdoor concrete floor (Fig. 7). Fruits turned at ripe stage, heaped for 24 hrs and then dried in the sun for about one week until they are soft and wrinkled. Women are using local basket for drying chilli and some places women are drying chillies on outdoor concrete floor (Fig. 7). Fruits turned at ripe stage, heaped for 24 hrs and then dried in the sun for about one week until they are soft and wrinkled. Women are using local basket for drying chilli and some places women are drying chillies on outdoor concrete floor (Fig. 7).
cleaned and exposed to sunlight for drying up and free from insect infection. The dried chillies are placed in the containers along with a pouch of fenugreek (Trigonella foenum-graecum L.) seed and mouth of container is airtight. The containers are kept in a dry and dark place. By this method chillies could be stored by women for 5 - 6 months without spoilage. Some marginal farmers are stored chillies in gunny bags after sun drying and grading. Usually, the farmers cleaned and bagged 15 - 20 kg of chillies in gunny bags, plastic bags and also in drum (made form tin) and kept in a clean dry store. But after packing most of the farmers are sell their produce without storing for better price. Women also store chilli in powder form and mixed common salt in chilli powder for longer storage. HYGROSOPIC quality of common salt helps in absorption of moisture content which in turn keeps chilli powder dry and avoids spoilage.

**Onion (Allium cepa L.) and garlic (Allium sativum L.)**

Onion and garlic are the commodities, which need everyday in every kitchen. For augmenting steady and continuous supply to domestic as well as overseas marketing their storage is highly essential. Storage of these commodities is a function of genotype, cultural practices and storage conditions. Annually about 55 - 60 lakh tonnes of onion are produced in the country out of that 10 - 12 lakh tonnes is wasted during handling, storage and marketing. Over last 30 yrs of research, technologies have been developed in terms of varieties, production, plant protection and storages by various institutes. However, effective transfer of technology and their adoption by farmers is not up to the desired level. Farmers still use their own knowledge and experiences for reducing storage losses. The onion bulbs are generally stored from May to November for a period of 4-6 months. However, 50-90% storage losses are recorded depending upon genotype and storage conditions. The total storage losses are comprised of physiological loss in weight (PLW), i.e. moisture loss and shrinkage (30-40%), rotting (20-30%) and sprouting (20-40%). The PLW can be minimized by harvesting at right time, proper curing of onion bulbs and subsequent storage at desired temperature and humidity conditions. Generally, the rotting losses are at peak in initial months of storage, particularly in June and July, when high temperature coupled with high humidity result the losses. However, proper grading and selection of quality bulbs and good ventilation conditions can reduce the rotting. Sprouting losses are usually recorded at the end of storage period or when exposed to high temperature of humid air. Noticeable sprouting losses are observed because of storage of poor quality bulbs having less rest and dormant period and also having thick neck. Comparatively, more sprouting losses are recorded in dark red and white onion cultivars than in the light red onion cultivars. Onion is prone to sprouting if the storage conditions are wrong, resulting in seed-heads at the top of the bulb stem and softening of the bulb. To reduce the moisture content onion is cleaned, trimmed roots and stems to about one inch spread them on a gunny bags to start drying in the sunshine. After drying these kept in cool and dry places and just snip off an onion when they need one. Cleaning, trimming, grading and storage activities are performed by women (Fig. 3).

Some of the families are stored onion in a mesh bags. Women are drying onion on outdoor ground floor in sun for 4-5 days (Fig. 4). Bulbs of onion and garlic are stored up to next season with 10-15% losses. Some of the families in Ganjam and Khurda districts of Odisha stored onions and garlic by simply tying them up and hanging them in bunches in the room/ burrandah (Figs. 5 & 6).

**Coriander (Coriandrum sativum L.)**

Women dried the coriander in sunlight for a 3-4 hrs and store in the form of powder in a plastic container with a small piece of 5 - 10 gm asafoetida (Ferula assafoetida L.) in the top layer. The strong/ pungent flavour and insecticidal and antimicrobial properties of asafoetida prevent the spices from insect pests.

**Discussion**

The post harvest losses of spices under traditional methods of storage appears to be enhancing shelf life by reduced moisture content and less- occurrence of pathogens. The control of post harvest losses by traditional methods of storage has also been obtained in ginger and turmeric.

**Conclusion**

India is an acknowledged leader in the world of spices and produces 45% of the world’s spices in terms of volume but the storage losses are very high. At micro- level, these losses increase the marketing cost of the product and at macro- level they also reduce the per capita availability. Thus, there is need to reduce these losses to feed the ever growing population. Farmers including women are involved in most of the storage activities of horticulture in general.
and spices in particular. Ginger and turmeric are stored in pit method, heap method and in situ method while chilli, onion and garlic are stored in a mesh bags and hanging method. Storage losses were recorded 10-15% in ginger, 20-30% in turmeric, 10-15% in onion and garlic in traditional method of storage which were less as compared to who has not adopted storage practices. To check these losses popularization and encouragement for low cost, eco-friendly and effective storage technologies and methods among the end users are the need of hour. The indigenous technical knowledge acquired by the farmers need to be tested and refined with the modern techniques. This will further help the farmers to enhance their capacity building especially in the trade sector. There is a scope of integrating traditional knowledge with modern scientific knowledge for developing appropriate technologies which will be a highly beneficial to the people living in the rural areas especially in the Agriculture sector. This will be useful to researchers to understand the issues related to storage technology development of spices in the state.

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