Traditional storage of farm p

Preserving the fruits of hard agricultural labour has always been a major concern of farmers. Over the years, they developed ways to treat and store harvested products, using only local resources. Until recently, these techniques formed an integral part of the informal education of youths. But the promotion of manufactured pesticides did not stop short of the villages. Particularly in the last two decades, chemicals have been introduced at an ever-increasing rate into peasant farming. Profiting sometimes from the label of modernism, they were often accepted without comparing their performance (preservation effects, environmental impact) with that of traditional techniques. Now, young people are no longer being taught how to use the local resources which could play such an important role in self-development. Here, some valuable traditional techniques in Mali are described.

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The setting is southern Mali in the Sudan zone. During the rainy season, from June to October, rainfall is 900-1200 mm. Temperatures vary between 20 and 40°C. Successful storage depends on a good fit between the major components of the chosen technology: the type and preparation of the storage container (granary, silo, jar, gourd) and the treatment or pretreatment of the products to be stored.

Storage containers

Traditional storage containers include cribs, granaries, silos, jars and gourds. They are mainly built by men, who learn the technique as they grow up.

Cribs, which have the double function of storing and drying corn cobs, are made of wood and thatch. In the humid savanna of southern Mali, the canes of *Flugia virosa* (in Bambara Mpalan-mpalan) are among the preferred building materials. The construction itself consists of a woven round wall with a conical thatched roof and is mounted on a stand about 1.5 m above ground. This guarantees good air circulation. The pre-dried cobs are put into the crib, under which a fire is lit. The fire is kept burning during the entire period needed for complete drying of the cobs (2-4 weeks). Sometimes, the cobs are also fumigated by adding insect-repelling leaves to the open fire. The cobs remain in these cribs for about 8 months.

Granaries are used for products which undergo little or no postharvest treatment, eg, millet and sorghum heads, and cowpeas and groundnuts in their shells. Also built of wood and thatch, the granaries provide good ventilation and protection from rainfall. The products are already dried before being stored, sometimes with additives for better preservation. Storage time is 6-8 months for legumes and 2-3 years for cereals.

Silos differ in shape and are either sunk into the ground (underground silos) or made of moulded clay, the so-called "banco". The underground silos are made in lateritic soil and are traditionally used to store fresh root crops (sweet potatoes, yams). The "banco" silos are mainly for cereals. They may be separate constructions with a thatch roof to protect from rain, or large receptacles inside the home. The former generally hold cereals (millet, sorghum, rice, acha) from the family farm. The latter belong to individuals and are preferred particularly by women for storing cereals from their own plots.

To make an outdoor silo, the loam or laterite must be carefully chosen; often material from termite mounds or loam from local deposits is used. Water and some stalks of acha (*Digitaria exilis*) are added, and the mass is left to ferment for at least a week. It is then well kneaded before starting construction. Sometimes, a wooden skeleton is used to stabilise the wall. The foundation is usually made of wooden timbers supported by rocks. The "banco" for making the first ca 50 cm of the silo wall is often mixed with additional substances, eg, the residue of fatty materials for waterproofing and plant extracts to repel insects. For better preservation of the stored product, the inside of the silo may also be whitewashed with active extracts.

Indoor silos are built along the same principles. However, important differences make the work more difficult, and much dexterity is demanded from the builder. These silos have no roof and no foundation. They are conical cylinders made of rings placed on top of each other and have at least two openings: one at the top and the others on the sides. They are built in the open, in a place exposed to the sun, using particularly carefully chosen and well-kneaded "banco". The rings are formed according to the dimensions of different levels of the silo, their weight being a crucial criterion. The silo is assembled and whitewashed, and the order of the rings is marked. Then, they are taken apart and moved, ring for ring, into the house.

Jars and gourds are small domestic receptacles used mostly by women to store small quantities of seed (rice, acha, cowpea, Bambara groundnut, sesame etc). If necessary, the products are treated before being stored.

Storage treatments

Traditional treatments for storage involve coating the storage container with plant extracts to ward off pests (rats, insects, mould); and/or treating the products directly with extracts (sprinkling, coating). The treatments are prepared and carried out by the owner of the stored product. Women often farm this task out to their husband or sons. The box summarises

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roducts

the main extracts used, treatment techniques and their effects. The most common forms of active extracts are:

- Powder made of green leaves. Leaves or leafy stalks are collected and crushed in a mortar. The crushed mass is dried in the sun, and then chopped and pulverised. The powder is sieved.
- Powder made of root bark. Roots are collected and cleaned by scraping the surface. The bark is removed with a knife and crushed in a mortar. The crushed mass is dried in the sun, then chopped and pulverised. The powder is sieved.
- Crushed plant mass for coating products. The plants (or their parts) are collected and crushed in a mortar, and may be mixed with further ingredients.

Exposure to smoke is also a common treatment. Seeds of vegetables (okra, pumpkin, tomato, pepper), maize, millet, cowpea and Bambara groundnut are well preserved by hanging them in the kitchen above the smoke of the cooking fire.

Extracts from non-indigenous essences such as neem (*Azadirachta indica*) are rarely used in the villages, mainly because these species are not widely distributed in the area and the villagers lack information about the preservative effects of these extracts.

Oil coating for medium-term grain preservation

The simple technique of oil coating is widespread in Mali. The dried grains (cereals, legumes) are well impregnated with oil or melted butter and stored in closed containers. As fatty substance, the non-edible residue from home production of oil or vegetable butter is most commonly used.

In Senegal, studies of this ancient preservation method revealed the following:

- 5 ml of oil are needed to treat 1 kg of grain;
- the coating has an inhibiting effect on insect eggs and larvae;
- a second treatment after about 12 days eliminates the risk of survival of any eggs and thus increases chances for good preservation;
- the effective preservation period is about 4 months, after which the treatment should be repeated;
- only about 20 kg of the product to be stored can be treated manually;
- storage can be done in simple containers such as jars, sacks etc.

To treat 100 kg of cowpea in this way, 5 ml/kg x 2 treatments x 100 kg = 1 litre of oil would be needed. At a price of 100-150 F/kg sheabutter in rural Mali, this would cost 150 FCFA at the most, if sheabutter of the local food quality is used (butter residue is even cheaper). In comparison, treatment with 2 capsules of carbon tetrachloride (eg, Trogocide) at local market price would cost at least 250-400 FCFA (1 FF = 50 FCFA). Thus, despite certain insufficiencies and inconveniences in its application, oil coating can compete with conventional chemical treatment.

Moreover, this technique could become even more competitive, as there are still possibilities for optimising it, such as:

- improving the coating procedure by using simple stirring devices;
- during or after coating, adding plant extracts with insect-repelling or insecticidal properties to the product to be stored.

Research and development should be aimed at optimising this traditional technique. Unfortunately, however, the rural extension services are promoting modern preservation methods based on external inputs and do not appear to be very interested in improving traditional techniques in the light of modern scientific knowledge.

Indigenous plants for preserving food and seeds

Many indigenous plants can be used to protect harvested crops from insect pests. Rice, Bambara groundnut, cowpea and cereal seed can be sprinkled inside the granary or sack with powder from the green leaves of *Cassia nigricans*. Seeds of vegetables (eg, okra, gourd, sorrel, cowpea) can be sprinkled or mixed with plant ashes before storing in a closed container. This also protects the seeds from mould. Powder from the vines and leaves of *Cissus quadrangularis* protects cowpea (seed as well as food grain) from insect pests for 1-2 years, when sprinkled inside the storage container. Cotton seeds can be protected by coating lightly with powder of buds and berries of *Diospiros mespiliformis* before drying and storing. To protect maize, millet, sorghum, acha and rice from insect pests and to keep the product in its original state, 5-10 cm layers of leafy stalks of *Flugia firosa* is alternated with layers of the crop. Sprinkling and mixing with powder from *Maerua angolensis* leaves, as well as coating tubers and the inside of storage containers, protects from insects and mould, maintains germination capacity and preserves the original state for up to 7 years (with maize, millet, sorghum, cowpea, Bambara groundnuts and tubers, eg, yams). Another insect repellent added to the inside coating of the silo (maize, millet, sorghum, acha and rice) is powder from the root bark of *Prosopis africana*. This also helps to preserve cereals for 3-5 years. Cowpea and Bambara groundnuts can be protected by coating the product with crushed *Prosofora senegalensis*, mixed with plant ashes. After coating, the product is dried in the sun before storage. Unripe fruits of *Pterocarpus santalinoides* can either be added as a crushed mass, or incorporated into the inner coating of the storage container, to protect maize, millet, sorghum, acha, rice, cowpea and groundnuts from insect pests for up to 7 years. The same group of farm products can be protected for 1-5 years by whitewashing the inside of the container with a powder-water emulsion of leaves and/or fruits of *Swartzia madagascariensis*. A 5 cm thick layer of this powder can also be spread in the container. Finally, residues of sheabutter can be used to coat seeds of cowpea and Bambara groundnut to preserve them.

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