

Capitalization Form

Spices production



- Tools and raw materials
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The development of the spice production and especially the drying activity allows the production of high added value products for the local market. The abundant seasonal supply in fresh products implies that fruit / vegetable / herbs are not valued to their full potential, particularly because of low market prices due to the high offer. In order to counter this, the products are transformed into dry products, which can be stored all year long and thus provide the market during the off-season, when the offer is at the lowest and prices are higher.

In addition, the creation of this new activity allows:

On the one hand, to diversify the sources of income and thus ensure the economic security of producers

On the other hand, to contribute to their skills building capacity and knowledge.

Among these productions, ginger, turmeric and lemongrass are plants well acclimatized to the conditions of the continents / tropical countries such as Africa, India and South Asia. Besides, their productions require little maintenance and are among the major ingredients used in the cuisine and medicine of these countries, making them, products with high development potential.

Description methods/tools

Tools and raw materials

The common / specific equipment required and their uses for the different processes are presented in the tables below. The number of tools depends on the number of people working and the quantity handled.

| Common tools | Uses |
|-------------------------------------|---|
| Knife + chopping board | To help removing the remaining peels after using the peeling machine (turmeric) and to peel or cut the products into pieces (lemongrass and ginger) |
| Scale + big bowl | To weight the products |
| Small stainless steel trays | To store the products after cutting them (lemongrass and ginger) or sorting them out (turmeric) |
| Plastic tray or basket | To store the products after cleaning |
| Big tray | To spread the products for drying in the solar dryer |
| Solar dryer | To dry the different products |
| Vaccum machine | To vaccum pack the products |
| Specific tools | Uses |
| Cooking Pot + Sieve + Stove + Spoon | To boil water, steam/blanch, roast and sieve (only needed for turmeric and lemongrass) |
| Scissors | To cut lemongrass |
| Peeling machine + grinder | To respectively peel turmeric and grind it |

The raw materials used in the following processes are:

| Raw materials | Quantity per production cycle | Origin |
|------------------|-------------------------------|---------------------------------------|
| Fresh lemongrass | 30 kg | Banteay Srey |
| Fresh turmeric | 100 kg | Banteay Srey |
| Fresh ginger | 30 kg | Banteay Srey |
| Water | - | Source of clean water from groundwell |



Harvest of lemongrass



Step 1.1



Step 1.2



Step 1.4

Lemongrass tea processing

Its process requires the harvesting and preparation of the leaves of lemongrass (*Cymbopogon nardus* and/or *Cymbopogon winterianus*). The harvest can be done as soon as the plant is more than 31cm tall and the stems have a diameter of at least 1cm. The cut is made at the base of the stem using a sickle or other sharp tools. It takes an average of 1 hour to harvest 100kg with a sickle.

The process can be divided in 4 main steps:

- ⇒ Step 1: Preparation of the lemongrass leaves before drying
- ⇒ Step 2: Drying
- ⇒ Step 3: Steaming and roasting
- ⇒ Step 4: Packing, labeling and storage

The entire process (steps 1 to 4) is carried out on the same day to ensure

Step 1 : Preparation of the lemongrass leaves before drying

After harvest, lemongrass leaves should be prepared according to the following procedure, so that it can be dried in the next step. Four people are taking part in the process during 6 to 7 hours per day (on 2 days), but the human resources are to be adjusted according to the quantity to prepare. Approximate times are given for 30kg of fresh lemongrass, which amounts to 6,5kg of final product.

| Steps | Time |
|---|---------|
| ⇒ Step 1.1: Sort out the leaves by cutting off with a scissor, the bad and old ones, then weight with the scale according to the quantity to be transformed, and clean them under running water | 30 min |
| ⇒ Step 1.2: Cut the leaves one by one with a knife about one centimeter from the base of the stem and keep only the upper part | 1 hour |
| ⇒ Step 1.3: Clean again the leaves under clear water and drain | 30 min |
| ⇒ Step 1.4: Cut the leaves with a scissor into pieces of about 1cm | 4 hours |



Analysis elements

- > The lemongrass cuts must be spread evenly on the trays of the dryer so as to dry homogeneously.
- > If the lemongrass is not dry enough, the time of drying should be extended.



Step 2



Solar dryer



Step 3.2



Step 3.3

Step 2 : Drying

The lemongrass cuts are then placed on the trays of the solar dryer and dried at 50°C for 12 hours. We advice to start the production early in the morning of the first day to allow enough time for the leaves to dry during the hot hours of the two days.

Step 3 : Steaming and roasting

Before steaming and roasting, the dried product is weighted. This also gives an information about the humidity level of the product. For 30kg of fresh lemongrass, we should weight 6,5kg of dried product. The following times are given to process this amount.

| Steps | Time |
|--|-----------------------|
| ⇒ Step 3.1: Fill a cooking pot with 1/4 of water and bring it to a boil | 10 min |
| ⇒ Step 3.2: Place the dried lemongrass in a sieve, cover it tightly and steam over boiling water for 150 seconds | 1h30 in small batches |
| ⇒ Step 3.3: Roast the steamed lemongrass in the cooking pot over low heat (30-40°C) and stir continuously for 5 min (without oil or water) | |

Step 4 : Packing, labeling and storage

The product is finally vaccum packed in plastic pockets of 1kg, labelled with the name of the product, the weight and the logo of Green Farmers. The product can be stored in cool, clean and dry place for 6 months. It takes about 15min to pack and label the 6,5kg of dried lemongrass.

Analysis elements

- > The ingredients are sourced in the immediate vicinity of the place of transformation (example of the neighborhood) to guarantee their freshness.
- > Hygiene is paramount: equipment (machines and tools) must be cleaned with alcohol after each cycle of production, and utensils sterilized in boiling water before use. The premises are also cleaned after each cycle.
- > Staffs must equip themselves with a clean apron, remove their shoes or wear shoes specific to the production area, cover their hair, wear gloves (disposable for the process), and wash their hands before starting production and after going to the bathroom.
- > Local legislation does not subject small-scale artisanal groups to the obligations of forward flow principle, labeling ... but attention is to be paid to compliance with the procedures of forward flow principle with (display of hygienic rules), bacteriological analyzes and batch traceability.
- > The final products are stored in airtight and clean boxes to prevent intrusion of pests.



Analysis elements

- > It is important to wait for the plants to reach their full maturity before harvesting their rhizomes, in order to get a good color and flavor.
- > Bioactive compounds and humidity levels in turmeric may vary depending on growth area, varieties, harvesting season, processing and storage conditions.
- > In order to improve the curcumin content in turmeric powder, one shouldn't store the fresh turmeric more than three days after harvest.



Zingiber officinale



Harvest of curcuma longa

Ginger and turmeric processing

Ginger (*Zingiber officinale*) and turmeric (*Curcuma longa*) are both perennial warm crops, which thrive best under warm and humid climatic conditions from sea level up to 1500 meters high. For the process, only the rhizomes are harvested when the plants reach their full maturity, ie. when the leaves change to yellow and pseudostems start drying gradually. In Cambodia, we consider the growing season starting around June/July, during the wet season and ending with the harvest 8 to 10 months later around May. For harvest, a light irrigation beforehand can loosen the soil and help the rhizomes to be lifted out with a spade or digging fork. It takes about 2 hours with 2 people to harvest a 100kg of rhizomes (for turmeric) so a bit less than 40min to harvest 30kg (for ginger).

The process can be divided in 7 and 5 steps respectively for turmeric and ginger. Though, as some parts are similar, in order to avoid redundancies, the common steps will be presented in one single table, mentioning if necessary the specificities for each, while the extra 2 steps of turmeric will be addressed separately.

The processes are each carried out over two days (to 3 days for turmeric) depending on weather conditions.

As the number of people working and quantities being processed per production cycle differ in each case, it has to be mentioned that the following times are given according to the number of people working and the quantities, as indicated in the table below.

| Steps / Quantity | Human resources | |
|--|---------------------|-------------------|
| | Turmeric processing | Ginger processing |
| ⇒ Step 1 to Step 3 | 2 people | 7 people |
| ⇒ Step 4 | 2 people | 1 people |
| ⇒ Step 5 | 3 people | 1 people |
| Quantity of fresh product per production cycle | 100 kg | 30 kg |

Ahead of each transformation the fresh products have to be weighted on the scale to estimate the quantity being transformed and therefore the quantity that should be obtained after drying.



Step 0



Step 1



Step 2



Step 3: cutting mother roots in quarters



Step 3: blanching



Step 4

Step 0 : Separating turmeric by size of rhizomes

The turmeric rhizomes are sorted out based on their diameter to constitute homogeneous groups. They are divided into two groups of (0,5 to 1 cm) and (1,1 to 1,7 cm) so as to benefit from the same drying and blanching conditions later on. It takes about 30 min to achieve it with 3 people

Turmeric and Ginger common steps

| Turmeric process | | Ginger process |
|---|---|--|
| Time | Steps & Method | Time |
| 2 hours | ⇒ Step 1: Cleaning The rhizomes should be cleaned with running clean water, then placed into clean baskets or trays to be stored at room temperature until the next step | 1 hour |
| 2 hours | ⇒ Step 2: Peeling After cleaning turmeric is peeled with the peeling machine in which water is added. In case the turmeric is not completely peeled, a sharp knife is used to remove the remaining peels by hand. For ginger, peeling is done by hand with a sharp knife or spoon. | 4 hours |
| 30 min blanching for 0,5 -1 cm | ⇒ Step 3: Cutting mother roots in quarters & Blanching (for turmeric ONLY) If necessary cut the mother roots in quarters for bigger ones. Blanching involves to boil the rhizomes in uniform batches of equal size roots, in proportion of respectively water and turmeric of 2:1. Each batch should contain between 50 to 75kg max. | |
| 45 min blanching for 1,1 -1,7 cm | Besides the blanching time depends on the thickness of the rhizomes and therefore should be adjusted to the duration given in the left column (no more than 1h) | |
| - | ⇒ Step 3: Slicing (for ginger ONLY) Slice the ginger as thin as possible. The thinner the slices, the quicker it will dry. It is important to slice them with an equal thickness to allow an homogeneous drying in the next step. | 2 hours |
| 14 to 16 hours of hottest hours (over 2 days) | ⇒ Step 4: Drying Rhizomes are placed on the solar dryer trays and dried at 50°C. The moisture content of fresh turmeric is around 81,5% and reduced to 8,5% after blanching + drying | 8 hours of hottest hours (over 2 days) |



Analysis elements

- > Blanching helps gelatinizing the starch for a uniform drying, removing the earthy odor, fixing the color and destroying microorganisms
- > Overcooking (more than 1h) destroys the color



Step 6: sieving



Step 6: packing



Step 2



Step 4

| Turmeric process | | Ginger process |
|--------------------------------------|--|----------------------------------|
| Time | Steps & Method | Time |
| 1 hour to pack 10kg per bag of 0,5kg | ⇒ Step 5: Packing, labeling and storage The products are finally vacuum packed in plastic pockets and labeled with the name of the product, the quantity and logo of Green Farmers. The products can be stored in cool, clean and dry place for 1 year for turmeric and 6 months for ginger | 15 min to pack 4,3kg per 1kg bag |

Step 6: Grinding and repacking dried turmeric

The grinding is done only on demand and a sufficient volume is required to be processed by the grinding machine. As previous stocks are kept vacuum packed in bulk, it can then be unpacked, grinded, sieved and repacked in pockets of 40g each when needed. Firstly the turmeric needs to be reduced from whole to small pieces and secondly from small cuts to powder. It takes on average 3 hours to grind 20 kg of dried turmeric into powder and 8 hours to vacuum pack it with 3 people.

Turmeric&Honey balls

From the production of turmeric powder, honey can be added to form the turmeric&honey balls. The process below is given for 4,8kg of final product, ie. 120 jars of 40g:

- ⇒ Step 1: Pour 2,5 kg of turmeric powder in a big stainless tray or bowl
- ⇒ Step 2: Dig a well in the middle and add 3L of honey
- ⇒ Step 3: Mix them well together with your hands (covered with gloves). It takes about 15 min for 1 person to complete this step
- ⇒ Step 4: Shape small balls of about 1cm diameter by rolling a bit of the mix between the palms of your hands (covered with gloves). Count 4 hours with 8 people
- ⇒ Step 5: Dry the obtained balls for 8 hours at 50°C in the solar dryer
- ⇒ Step 6: Put them in glass jars and label them. They can be stored up to 6 months. This step is achieved in 2 hours by 2 people



Analysis elements

- > The solar dryer should protect the products from direct UV, especially as the curcumin in turmeric is sensitive to UV light. Besides, as the dryer is used by the community, it should be simple and easy to use, with easy maintenance and cleaning.
- > In terms of economic saving, the community doesn't need to pay electricity charges
- > Vacuum packing helps to preserve the properties of the products and to keep them for a longer time



To remember...

The fresh products are delivered on the first day of transformation for optimal quality.

In order to preserve the products over a long time, careful attention should be given to the drying and vacuum packing steps. As humidity level vary depending on many factors, it is necessary to make sure that the products are dry enough before packing.

The application of good hygiene practices and rules is essential throughout the production, storage and distribution cycle to ensure a quality product.

The staff is trained and has the management tools necessary for the proper process (stock book, purchase and sales book, hygiene rules, step-by-step production checklist).

Results

| | Lemongrass tea | Dried ginger | Dried turmeric | Honey balls |
|--|--|--|--|---|
| Key elements of Demand | | | | |
| Quantity sold | 1 kg minimum | 1 kg minimum | One bag = 40g | One jar = 40g |
| Price (usd) | 8 per kg | 28 per kg | 20 per kg | 2,50 per jar |
| Quality requirements | Product certified safe by the analysis laboratory | | | |
| Technical results | | | | |
| Yield | 22% | 14% | 10% | 87% |
| Volume produced/cycle | 6,5 kg in 2 days (about 14hours) with 4 workers | 4,3 kg in 2 days (about 16 hours) | 10 kg in 2 to 3 days (about 21 hours) without grinding | 4,8 kg in 2 days (about 14h30) |
| Economic results | | | | |
| Production cost (usd) | 3,56 per kg | 14,99 per kg | 10,45 per kg | 2,03 per jar |
| | Production costs vary according to input prices. The cost of production is calculated without taking into account investment costs in machinery and premises because they are covered by the project and are therefore not counted as depreciation. Besides, the cost of labor is calculated on the profit and does not intervene in the calculation of the production cost. | | | |
| Profit (usd) before subtraction of labor charges | 4,44 per kg ie. 125% of production cost | 13,01 per kg ie. 87% of production cost | 9,55 per kg ie. 91% of production cost | 0,47 per jar ie. 23% of production cost |
| Volume sold/period | 10kg in one month (product has just been launched) | No sales record - (product has just been launched) | 25,2kg in two months (product has just been launched) | 20kg in 2 months (product has just been launched) |

Input prices: Fresh lemongrass = 0,37 usd/kg ; Fresh ginger = 1,75 usd/kg ; Fresh turmeric = 0,5 usd/kg ; Honey = 25 usd/L

Electricity = 0,25 usd/kw ; Delivery = 0,2 per kg from farm to processing place ; Hygiene materials = max 5% of total expenses ; Label = average 1 usd/10 stickers ; packaging = 0,25 usd/bag of 1kg ; glass jar = 1 usd/jar

Labor cost = average 5 usd/person/8 hours work

Cost of machinery: Peeling machine = 200usd for the small and 250usd for the big one ; Grinding machine = 550usd for a small one ; Solar dryer = 3924usd ; Vacuum machine = 850usd for a medium sized one

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