

# GROUNDNUT OIL

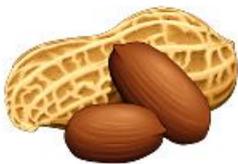




## GROUNDNUT OIL

### 1.-Groundnut oil extraction using a manual screw press

This sheet gives a detailed overview of processing groundnut oil using a manual screw press. It is taken from the ITDG publication (The Manual Screw Press by K Potts and K Machell (ref no 7)).



### 2.-Processing details for groundnut

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#### 2.1.-Preparation of raw material

The best available groundnuts should be used for oil production to increase yields and reduce the risk of disease. This requires testing for oil and moisture content. It is important to ensure that a sufficient supply of raw materials is available for the planned level of production.

If a supply of groundnuts has to be purchased, buying in bulk can ensure that the raw material requirements are met, but it may present other problems: increased size of storage facilities; higher capital investment; improved quality control measures to reduce the risk of spoilage during storage; additional labour to shell the groundnuts.

An alternative strategy to ensure a continual supply of raw materials is to take out a contract with a supplier so that raw materials are purchased at regular intervals. This reduces the capital requirements, the need for large storage facilities and improves cash flow.

## **2.2.-Storage or raw material**

When groundnuts are stored for a long time, they should be stored in their shells. Good storage facilities are needed to reduce losses and ensure the oilseed is of high quality. Deterioration occurs as a result of a number of factors including: the growth of micro-organisms, infestation of insects, rodents eating the oilseeds, human mishandling of oilseeds, use of poor storage containers and sacks, exposure to extremes of temperature and moisture.

The storage building may or may not be attached to the production site, but it should be clean, cool and ventilated.

Inside the building the seed should be stored in sacks that are tied with string and are free from holes. The sacks should be kept off the floor on a platform of bricks or wooden poles. This prevents the uptake of water from the ground.

The sacks should not be stacked against the walls as insects can get into the oilseeds from the walls.

The sacks should be neatly stacked on top of each other, with space between the stacks for air to circulate.

The oil and oilcake should be stored in a separate place to the raw material.

## **2.3.-Dehulling/Shelling**

When groundnuts are stored for a long time, they are purchased in their shells. The shells need removing prior to oil extraction.

Various dehulling machines are available or the seeds can be shelled by hand.

Groundnut shellers are usually evaluated in terms of the percentage of broken kernels produced (the higher the percentage, the worse the design).

If the shellers are only being used for oil processing, this does not matter since there is no need to obtain whole kernels.

When oilseeds are shelled on site, the extra equipment and labour costs required must be calculated.

## **2.4.-Grading**

The groundnuts must be sorted and graded to check for damaged, shrivelled and mouldy seeds which may carry aflatoxin. These must be removed and destroyed.

### **Grading groundnuts**

Before starting to grade, weigh the groundnuts using a spring balance scale. Write down the weight (A). Spread small quantities of seeds on a well illuminated light-coloured surface or cloth. Remove damaged seeds by hand and discard them.

Also remove stones and other plant material.

Weigh the remaining seeds. Record the weight (B). Store the seeds in closed sacks off the ground in a dry, well ventilated storeroom.

Destroy the aflatoxic seeds by burning them.

Calculate the percentage loss.

The quantity of seeds discarded is the difference between weights A and B. The percentage loss is calculated as follows:

$$\text{percentage loss} = \frac{\text{quantity of seeds discarded}}{\text{total quantity before grading}} * 100$$

Losses up to 5% are acceptable. However, losses over 5% are not acceptable. The suppliers should be informed and efforts made to improve quality.

## **2.5.-Crushing**

Only graded nuts and seeds should be crushed.

The nuts are crushed to reduce the particle size and increase the surface area to produce more oil. The reduced size also makes pressing easier.

Whole nuts or seeds are much more difficult to press and will only produce a small amount of oil.

There are two ways to crush the nuts - traditional hand pounding in a mortar and pestle or using a roller mill.

### **- Traditional hand crushing –**

#### **Advantages**

It is a traditional process and is likely to be familiar and therefore easier. It is labour intensive and therefore creates more job opportunities. It uses low cost locally made equipment which can easily be replaced. It reduces capital investment costs.

#### **Disadvantages**

The losses are increased. It is a laborious and tedious process. To keep up with production levels of 10-12 batches per day it may be necessary to crush one day in advance of production. It produces a flour of variable consistency which can lead to variations in the final oil yield.

#### **How to crush by hand**

Hand pounding uses the traditional mortar and pestle. The graded nuts or seeds are first weighed and the weight recorded (weight A).

The nuts or seeds are pounded into small particles (coarse flour). The coarse flour is winnowed to separate the skins and coarse flour from the fine flour.

The coarse flour is returned to the mortar and pounded again and then winnowed to remove the husks. This process is continued until a fine flour is produced. The flour is weighed and recorded (weight B).

Losses from hand pounding can be as high as 6 per cent.

This can be caused by: overfilling the mortars; careless winnowing; inaccurate weighing and consumption of groundnuts by staff.

Milling losses can be calculated as follows:

$$\text{Percentage loss} = \frac{A - B}{A} \times 100$$

A = weight of graded seeds (kg)

B = Weight of flour (kg)

After crushing, flour can easily pick up moisture from the air and should be stored properly in sealed sacks. If possible, nylon sacks should be used as they are more resistant to infestation than jute sacks.

### **- Crushing with a roller mill -**

Crushing with a roller mill is still hard work and requires two people for its operation. However, it does speed up the crushing process and

#### **° Advantages**

Less tedious and strenuous than hand crushing.

Increased productivity to match throughput of oil press.

Reduced milling losses.

Fewer problems with storage of flour.

Flour produced is of consistent quality and grade and therefore there is less variation in oil yield.

Oilseeds can be crushed on the day of production rather than a day in advance.

#### **° Disadvantages**

Less labour intensive.

More complicated equipment.

Higher capital investment.

The roller mill consists of two mild steel rollers mounted in a frame. A seed hopper containing the seed is mounted above the rollers. A chute takes the crushed seed from the rollers to the collecting bag. One of the metal rollers is fixed while the position of the second roller can be adjusted so that the gap between the two rollers can be adjusted according to the size of the seed being milled. The roller gap can easily be adjusted by inserting mild steel plates or spacers between the rollers during adjustment.

Groundnut crushing is a two stage operation; first at a 2mm gap and then at a 1mm roller gap to produce a fine flour. Different varieties of groundnut may be larger than this and the roller settings may need further adjustment to get the best performance.

### Using a roller mill.

1. Adjust the roller gap setting to 2mm:

- \* Slacken off the two adjusting screws fixed to the movable roller.
- \* Loosen the bolts holding the bearings and roller shaft to the frame.
- \* Insert the 2mm spacer between the two rollers by moving the adjustable roller until the spacer is held firmly between the two rollers.
- \* Hold the roller firmly in place and tighten the bearing bolts to the frame so that the roller is held firmly in position.
- \* Remove the spacer from between the rollers.

2. Fill the seed hopper with graded groundnut kernels. Remove the slide plate at the base of the hopper so that the kernels fall onto the rollers.

3. The first stage of the crushing operation involves the operator turning the rollers towards each other at approximately the same speed. The partially crushed material is scraped from the rollers by two scraper blades and falls into the collecting sacks.

4. Refill the hopper as necessary until the desired quantity of nuts are crushed.

5. The partially crushed groundnuts with loosened skins are winnowed to remove the skins. This is optional, but has several advantages:

- \* it improves the colour, odour and taste of the oil. The darker coloured groundnut varieties can stain the oil and are best removed. Light skinned varieties may not need to be winnowed.
- \* it improves the taste and appearance of the oilcake. The skins can easily char during heating and produce a burnt tasting darker coloured cake.
- \* there is a marginally improved efficiency and yield of oil.

Winnowing can be carried out by hand using a tray.

6. The second crushing. Adjust the roller gap to 0.5-1mm using a spacer. Put the partially crushed seeds into the hopper and run through the mill a second time.

Milling losses are lower when using a roller mill. They are calculated in the same way:

$$\text{Percentage loss} = \frac{A - B}{A} \times 100$$

A = weight of graded seeds (kg)

B = Weight of flour (kg)

To get the best performance from the roller mill, and to avoid unnecessary breakdowns, it should be looked after carefully.

## 2.6.-Addition of water

Water is added to the flour to assist in rupturing the oil-bearing cells. It also helps to assure even heating of the groundnut flour.

The amount of water added depends on the oilseeds used. With groundnuts it is usual to add 10% water by weight - that is, 1 litre of water for every 10kg of groundnut flour. It may be necessary to experiment with to find the optimum amount of water to add.

**How to add water.** For one pressing of groundnuts, you need 10kg flour. For ease of mixing and heating, this is divided into two parts and placed in two tin baths.

For each 5kg, add 500ml water. Use a 1 litre measuring jug. Fill to the top and pour 500ml into the first bath and the remainder into the second bath. Do not pour the water into one place as it will be difficult to mix. Pour it in a snaking pattern across all the flour.

Rub the water into the flour with the fingers, ensuring that all the flour is taken from the edges and bottom of the bath. This will take up to 5 minutes.

At the end of mixing there should be no dry flour left at the bottom of the bath.

Transfer the flour to the heating pans.

## 2.7.-Heat

Heating assists in breaking the cell walls and opens the cells that contain the oil. It also decreases the thickness of the oil so that it flows out more easily.

**Heating the flour.** At the beginning of the day the fuel required for the days production should be prepared. The fires should be well started by the time they are needed for heating the flour. Only a low fire is needed - charcoal is a good fuel to use.

Transfer the flour into the heating pans - 5kg in each pan. As soon as the pan is placed on the heat, the flour must be stirred. This is continued throughout heating to prevent burning and to aid even heating. It is very easy to overheat the flour, therefore it should be watched closely.

The time of heating depends on the temperature of flour and its water content. The mixture should be heated for long enough to reduce the water content and raise the temperature to about 90°C. This normally takes about 10-15 minutes. When ready, the flour should be quite dry and hot to the touch. If the flour is not heated enough, there will be too much water remaining in the flour. This will cause the heated flour to pass out of the holes in the press cage.

If black smoke appears, it means that the flour is overheated. The oilcake will have a dark colour and a strong odour and taste. If there is insufficient water, the flour will char and will be too dry. There will be a low yield of oil.

**The handfeel test.** This test is used to tell when the heating stage is completed. It takes some time and practice to master. When the flour and water mixture is initially heated, the mixture is sticky and when pressed in the hand it will stick together to form a lump or ball of material. During heating, small handfuls of the material should be picked from the pan and pressed in the hand.

If the material sticks together, it is still too wet and heating should be continued. As heating continues it can be noticed that the material gradually becomes hotter and drier. When the material can be squeezed in the hand and it does not form a lump, but is free-flowing, the heating is completed and it is ready for pressing.

## **2.8.- Filling the press**

The press should be filled quickly so that the flour does not cool down too much. A loss in temperature will reduce the oil yield. Good planning is essential to avoid this happening.

Before each pressing the press cage and plates should be placed in the sun to warm. This increases the yield of oil. If the cage is cold it will absorb heat from the groundnut flour.

**Filling the press.** Remove the heating pans from the heat one at a time. Transfer the flour to the press using a tin cup.

Place the press cage on the collecting tray with a press-plate inside the cage at the bottom. This prevents the flour sticking to the collecting tray. Fill the cage with five cups of heated flour and add another press plate.

Press down on the plate and add another five cups of heated flour.

Continue like this until all the heated flour has been placed in the press cage.

Once all the flour has been poured into the press, place the final press-plate on top. This prevents the cake sticking to the underneath of the pressure plate. In total five divider plates are used.

Press plates are used to equalise the pressure throughout the press cage and to help the flow of oil. They also make it easier to empty the oilcake from the cage by dividing it into several pieces.

Wipe any spilt flour off the collecting tray, position the cage carefully under the pressure plate and place one 3 litre tin bucket under each hole under the collecting tray.

## **2.9.-Pressing**

Position the filled cage under the pressure plate. One person should slowly lower the pressure plate by turning the small handle with one hand in a clockwise direction.

Once the handle becomes too stiff for one person, attach the two arms. One person should stand at the end of each arm and slowly walk round the press pushing the arms.

The pressing should not be performed too quickly. As soon as oil starts to flow out of the holes of the cage, stop pressing until the flow ceases. Then continue.

Carry on pressing like this until it becomes too difficult for two people. For the final stages of pressing, four people are needed to turn the press. When no more oil flows out, stop pressing.

This usually happens when the fifth thread of the screw is reached. To help collect as much oil as possible, rubber scrapers can be used to remove the residual oil from the oil tray. Care must be taken not to pick up any grease from the screw thread as this will contaminate the oil. There is sometimes oil above the top press-plate. This can be collected using a clean sponge or paint brush and squeezed on to the oil tray.

The oil released from the cage flows onto the collecting tray, which is angled so that the oil can leave the tray via the two holes and can be collected in buckets placed beneath the holes. After pressing, the oil in the buckets is measured in the measuring cylinder and the amount recorded.

The yield of oil per batch will vary with the quality and oil content of the seeds. It can be expected to vary from 3 to 4 litres per batch. Filters can be used to remove any solid particles.

## **2.10.-Removing the oilcake**

Remove the arms from the top screw. One person should then raise the screw by turning it in an anti-clockwise direction. It is important that the screw is not rewound too far as this will damage the press.

Stop turning the screw when the end of the screw or pressure plate is close to the frame. Lift the cage and hang it on the two brackets on the inside of the frame. Make sure that the cage is attached to both brackets, otherwise it will twist and damage the screw.

Relower the screw, turning the handle in a clockwise direction. It may be necessary to attach one of the arms. When the handle is turned, the cake is pushed from the cage and falls onto the collecting tray. The discs of oil cake will be stuck to the press plates and can be separated by a metal scraper.

They should be allowed to cool before storage. Particles of cake sticking to the plates can be scraped off, cooled and stored separately.

As one person is turning the handle, another person should be collecting the cake as it falls out of the bottom of the cage, piece by piece. The cake should be put into a container, not on the floor.

## **2.11.-Measuring the oil**

It is important to measure the amount of oil that has been expressed. This allows you to keep records, which are important for the running of the business. It also enables you to assess the efficiency of the press.

To measure the oil you will need a 5 litre measuring jug, a sieve or tea strainer and a 15 litre bucket with a lid.

Place the sieve above the measuring jug. Slowly pour the oil from the collecting buckets through the sieve into the measuring jug. Pour the oil until it reaches the 5 litre mark. Transfer this oil to a clean 15 litre bucket.

Continue measuring the oil 5 litres at a time until all the oil has been measured. Make a record of the total quantity.

Transfer the oil to another bucket that contains oil which has reached the same stage of production. Place in the storeroom with all other unheated oil.

## **2.12.-Filtering the oil**

The newly pressed oil will be slightly cloudy because of the effect of air and small particles of solid material that have passed through the strainer.

The oil should be allowed to stand for 48-72 hours to clarify. Then, most of the clear oil can be carefully poured off or siphoned from the container and stored ready for heating.

If groundnut oil is heated without being left to stand for 48-72 hours, the oil will be a dull colour and will foam when cooking.

The remaining mixture of solid particles and oil in the bottom of the bucket can be filtered through a brown paper funnel over several days to remove the final solids from the oil. After filtering, the solid material can be added to the material for the next pressing.

Newspaper should not be used as filter paper as some printing inks are poisonous and can leak into the oil. To make a high quality oil that has a good, clear appearance, care should be taken over the filtering and heating stages.

### **2.13.-Heating the oil**

After filtering, it is recommended that the oil is lightly heated. There are several benefits of heating the oil:

- it removes any residual water from the oil and therefore improves the keeping quality of the oil.
- it improves the odour and taste of the oil as some flavour compounds are driven off during heating.
- it reduces the incidence of any spoilage organisms in the oil.

The filtered oil can be stored for one week and heated at the end of each weeks production. Do not let too large a stock of filtered oil accumulate before it is heated.

Place the oil in a large pan and heat gently over a low fire.

Make sure that someone is watching the oil as it will darken if heated too strongly or for too long.

After heating, allow the oil to cool in the heating pans before transferring the oil to storage containers that are labelled 'heated oil' and are dated.

Do not mix heated and unheated oils together.

There are two ways of knowing when the oil has been heated enough and needs to be removed from the fire:

**Using a probe thermometer.** Oil is ready at temperatures between 90°C and 110°C.

**Observation.** When you see bubbles moving around in the oil, it is ready to be taken off the heat.

**Safety.** Oil is a difficult material to handle and care should be taken when handling and pouring hot oil to avoid the danger of burning. Avoid needlessly transferring the oil from one container to another. Any oil that is spilt should be wiped up immediately.

Remember the following guidelines for the safe handling of oil:

- Oil should be heated at the end of the day, just before everybody goes home.

- Animals and children should be kept away from the production area.
- There should be no running around the site at any time.
- Do not leave any items of equipment lying around.
- Wipe up any oil spills immediately.
- Follow the recommended maintenance procedures for equipment.

## **2.14.-Storage of the oil**

Proper storage of the oil is essential if the quality of the oil is to be maintained until sale. If oil is stored incorrectly, it can go rancid and develop an off odour and taste.

Rancidity is caused by chemical reactions between oil and any water or air present.

Therefore, to reduce rancidity, contact with water and air should be avoided during storage.

The reactions are speeded up in sunlight, therefore the containers of oil should be stored away from direct sunlight. When correctly stored, the oil should remain in good condition for at least six months.

Any residual water should be removed during heating of the oil. Unheated oil has a reduced storage life.

Make sure that all containers used to store the oil are clean and dry before filling with oil.

Never top up a container of old oil with new oil. The old oil may be rancid and will spoil the new oil.

Always use clean containers. Make sure the container is filled to the top. This reduces the amount of air present in the bottle or container.

Make sure the container has a secure lid or top to reduce the possibility of spillage or of contamination by water, dust or insects.

**Storage containers.** Any suitable sized, locally available plastic container can be used. From a 20 litre jerry can to a 200 litre plastic drum. Make sure that it has a tight fitting lid or seal, it is clean and free from odours and it is not cracked or broken. Many drums originally contained chemicals. Therefore they should be carefully washed before use to remove any contamination or odours.

The containers should always be stored away from sunlight, in a cool dry place and in a safe place where they cannot be knocked over.

## **2.15.-Storage of the oilcake**

The weight of oilcake must be measured. This is important as it helps to assess the efficiency of the process.

It is also essential for keeping sales and stocks records and for monitoring losses.

The weight of oilcake should include both the weight of the cakes or discs produced and the loose cake material or crumbs that are scraped from the press plates as this can still be sold.

The oilcake should be stored correctly to ensure that it remains in good condition. The oilcake should be cooled before it is packed into bags. It is best stored in sacks that are tied with string.

The oilcake should be cooled before it is packed into bags. It is best stored in sacks that are tied with string.

The sacks of oilcakes should be stored in a cool, dry place off the ground. Sacks should be labelled with the weight and the date produced.

The stock of oilcake should be rotated, selling the oldest stock first.

Oilcake keeps well in good storage conditions. Oilcake that has become wet or mouldy should be discarded as there is a possible risk of aflatoxin.

Oilcake is dry and contains some residual oil, so it can easily catch fire. Smoking should not be allowed in the oilcake store or in the processing area.

Precautions should be taken against rodent attack and infestation by birds and other animals.

## **2.16.-Sale of oil**

There are several options for selling the oil. The choice will depend on the local situation and resources.

### **- Bulk sales -**

#### **Advantages**

Reduced cost of packaging material

Lower labour costs for packaging and selling

Simple distribution process

#### **Disadvantages**

Lower selling price

### **- Wholesale bottled sales -**

#### **° Advantages**

Higher selling price

Extra local labour can be employed

Simple distribution process

A brand name can be established

#### **° Disadvantages**

Erratic availability of packaging materials

Additional expenditure on bottling equipment

Higher labour costs

A high standard of quality control has to be maintained

Responsibility for labelling

### **- Retailing directly from the processing site -**

#### **Advantages**

Control over the retail price of oil

Option of selling at a lower price if customers provide their own container

#### **Disadvantages**

No incentive for local retailers to market oil

The existing market chains are not utilised

Expenditure needed for sales staff

Size of local market may be too small for the amount of oil produced

It is essential to establish the method of selling oil at the start.

If oil is sold into customers own containers, these must be clean and dry.

Records should be kept of all sales: date, quantity, receipts and customer details.

Regardless of the method of selling oil, before setting up production it is essential that a market survey is carried out to identify the following:

- ° who will buy the oil
- ° the selling price
- ° the size of the market or the likely demand for oil
- ° how the oil will be transported

The selling price of oil. When calculating the selling price you have to remember to include all the costs and to make a profit. The following must all be included:

- ° Production cost
- ° Packaging of the oil - material, labour, labels etc
- ° Transportation to the retailer or wholesaler
- ° Promotion cost
- ° Profit

When the selling price has been calculated, add on what you estimate the retailers mark up will be and compare this price with the products already available locally. If the final price is the same or higher than that of existing products, you must be offering a product of better quality and presentation backed up by a reliable supply service.

If the selling price is much higher than those already available, it is unlikely that you will be successful as oil is a basic commodity and price is one of the main factors considered by the consumer.

## **2.17.-Marketing oilcake**

Successful marketing of the oilcake is essential for the enterprise to be successful. The process must be started before production begins.

The most likely market for oilcake is animal feed mills.

When oil is produced at large centralised factories, the oilcake is rarely seen on the market as it is sold on directly to large animal feed mills.

In rural areas it may be necessary to find out who buys animal feed and target that market.

Another entrepreneur may want to set up an animal food mill, or it may be worth incorporating an animal feed mill into the oil business if there is no other outlet locally.

In some places, groundnut flour is a traditional item in the human diet and groundnut oilcake can be marketed as a substitute. Where flour is used in a recipe it is possible to substitute up to 25-50% flour with the oilcake. This can lower the cost of baked goods while increasing their nutritional value.

If the oil cake is crushed before sale, the price should be increased to cover the labour costs.

Sunflower oilcake is not suitable for human consumption. Its main use is for animal feed.

## **2.18.-Roller mill maintenance**

To get the best performance from the mill, it is necessary to take care of the equipment.

### **Tools needed**

Stiff brush for cleaning

Roller groove cleaner (a bicycle spoke is suitable)

17mm spanner

3mm Allen key

0.5, 1.0 and 2.0mm metal spacers or hacksaw blades for setting up the roller gap

### **Maintenance schedule**

- *End of each day*

- \* clean roller grooves with the groove cleaner
- \* brush nut/flour deposits from rollers and scraper blades.

- *End of each week*

- \* remove feed guide from the feed hopper and clean nut deposits from the shut-off valve.
- \* check the allen screws and roller bearings are tight.

- \* check the scraper blades and adjust them if necessary.
- \* lightly grease the roller, adjusting the screw threads.

- *End of each month*

- \* remove the feed hopper and guide, clean and replace.
- \* remove the discharge chute, clean and replace.

## **2.19.-Safety and hygiene**

### **Reference. ITDG (1995)**

Safety and hygiene are both important. Both oil and oilcake are foodstuffs and therefore should be handled in a clean and hygienic manner. Oil is a difficult material to handle and care should be taken when handling or pouring to reduce spillage and wastage as much as possible.

### **Safety**

- \* Avoid transferring the oil from one container to another unless really necessary.
- \* Any oil that is spilt should be wiped up immediately to avoid the risk of accidents.

Take care to avoid burns through bad handling and accidents.

To reduce the chance of accidents by burning, oil should be heated at the end of the day before everybody goes home, so that when they arrive the following day the oil is cool.

Follow the recommended maintenance procedures for equipment.

Do not leave equipment lying around. Store it properly when not in use.

Send samples of the oil and cake for regular aflatoxin analysis.

Animals and poultry should be excluded from the production area.

Keep children away from the machinery and oil.

### **Hygiene**

Workers should not eat in the workplace.

Washing facilities should be available to the staff. Hands must be washed at the beginning and end of each day and after each visit to the toilet.

All processing equipment should be cleaned with soap and water at the end of each day and dried. Holes in the oil cage can become clogged with solid material which should be removed with a thin metal spike or wire brush.

All floors should be brushed daily and washed once a week with soap and water.

Open doors and windows should be screened with chicken mesh to prevent birds and insects entering.

Discarded materials and waste products should be disposed of or buried away from the processing site so they do not attract pests.

If oil is sold into the customers own container, make sure the containers are clean.