

PRINCIPLES OF OIL EXTRACTION

Oil is extracted from a number of fruits, nuts and seeds (Table 1) for use in cooking and soapmaking¹ or as an ingredient in other foods such as baked or fried goods. Oil is a valuable product with universal demand, and the possible income from oil extraction is therefore often enough to justify the relatively high cost of setting up and running a small scale oil milling business.

	Moisture content (%)	Oil/fat content (%)	Yield of oil (%)	Uses for by-products
Seeds and beans				
Cotton	5	15-25	-	Animal feed
Rape	9	40-45	25	Animal feed (needs detoxifying)
Mustard	7	25-45	-	-
Sesame	5	25-50	45	-
Sunflower	5	25-50	20-30*	Animal feed Hulls used for chicken litter, presscake for animal feed
Safflower	5	30	-	Animal feed
Nuts				
Coconut (fresh)	40-50	35-40	55-62	See Fig 8
Copra	3 – 4.5	64-70	-	-
Groundnut (shelled)	4	28-55	40*	Food, snacks, soup
Palm kernel nuts (shelled)	-	-	45-49	Animal feed
Shea nut	-	46-57	47-51	Animal feed, fuel (shells)
Shea nut	-	34-44	15-45*	Fuel
Shea nut	-	-	60	-
Fruits				
Oil palm	-	56	11-20	Fuel, lighting
Avocado	69	11-28	40-44	-
Olive	50-70	-	25	Animal feed, fuel

*Traditional methods

Raw material preparation

Oilseeds and nuts should be properly dried before storage, and cleaned to remove sand, dust, leaves and other contaminants. Fruits should be harvested when fully ripe, cleaned and handled carefully to reduce bruising and splitting. All raw materials should be sorted to remove stones etc. and especially mouldy nuts, which can cause aflatoxin poisoning. When storage is necessary, this should be in weatherproof, ventilated rooms which are protected against birds, insects and rodents. Some raw materials (for example groundnuts, sunflower seeds) need dehusking (or decortication). Small manual machines are available to give higher production rates than manual dehusking (Figure 1).

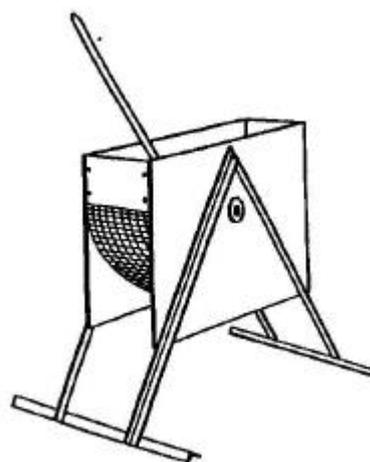


Figure 1: A Decortication Machine

¹ See Technical Brief: 'Soapmaking'.

Dehusking is important to give high yields of oil and reduce the bulk of material to be processed' but in groundnut oil extraction about 10% by weight of husk should be added back to the nuts to allow oil to escape more freely from the press. Coconut is dehusked and split by skilled operators as this is faster than the available small-scale machines. Most nuts need grinding before oil extraction to increase the yield of oil. Small mills are available for grinding copra, palm kernels and groundnuts.

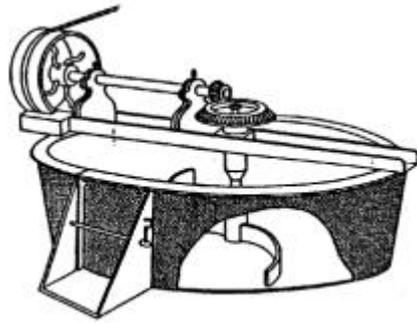


Figure 2: A Seed Scorcher

Some seeds (e.g. groundnuts) are conditioned by heating to 80-90°C using a seed scorcher (Figure 2), and all oil-bearing materials need to have the correct moisture content to maximise the oil yield. Other oilseeds and nuts are usually processed cold provided that their moisture content is below about 7%.

Methods of extraction

There are basically three methods of removing oil from the raw materials: solvent extraction, wet processing or dry processing. Solvent extraction is not suitable for small-scale processing because of high capital and operating costs, the risk of fire and explosions from solvents and the complexity of the process. Equipment for wet or dry processing is available at different scales of operation from household to industrial scale. Traditional methods of extraction are described below, followed by higher output manual machines and mechanised extraction.

Traditional methods

Oil is extracted from fresh coconut, olives, palm fruit shea nut etc. by separating the flesh and boiling it in water. Salt is added to break the emulsion and the oil is skimmed from the surface. In palm oil processing the fruit is first heated in a 'digester'.

Manual methods

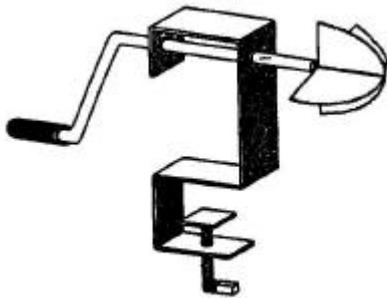


Figure 3: A Manual Reamer

Oil can be extracted by pressing softer oilseeds and nuts, such as groundnuts and shea nuts, whereas harder, more fibrous materials such as copra and sunflower seed are processed using ghanis. Pulped or ground material is loaded into a manual or hydraulic press to squeeze out the oil-water emulsion. This is more efficient at removing oil than traditional hand squeezing, allowing higher production rates.

Fresh coconut meat is removed from the shell using a manual reamer (Figure 3) or a motorised reamer. The fine particles are pressed in a similar way to extract the oil emulsion. The emulsion is broken and the oil is then separated and clarified (see below).

Presses have a number of different designs, which can be grouped into screw or hydraulic operation. Both types can be manual or motor driven. In all types, a batch of raw material is placed in a heavy duty perforated metal 'cage' and pressed by the movement of a heavy metal plunger. The amount of material in the cage varies from 5-30 kg with an average of 20 kg. Layer plates can be used in larger cages to reduce the thickness of the layer of raw material and

technical brief



speed up removal of oil. The pressure should be increased slowly to allow time for the oil to escape. Screw types are more reliable than hydraulic types but are slower and produce less pressure. Except where a lorry jack is used (Figure 4), hydraulic types are more expensive, need more maintenance, and risk contaminating oil with poisonous hydraulic fluid.

Ghanis are widely used in Asia but less so in other areas. A heavy wooden or metal pestle is driven inside a large metal or wooden mortar (Figure 5a). The batch of raw material is ground and pressed and the oil drains out. They have relatively high capital and maintenance costs and need skilled operators to achieve high oil yields.

Figure 4: Hydraulic Oil Expeller

Mechanised extraction

Motorised presses are faster than manual or animal types

(Figure 5a) but are more expensive. Motorised ghanis (Figure 5b) are also available, but their higher capital and operating costs require a larger scale of production for profitability.

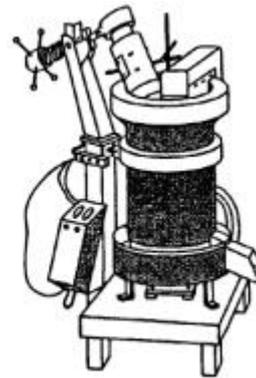


Figure 5a: Animal Powered Extraction Figure 5b: Motorised Extraction

Expellers are continuous in operation and work by grinding and pressing the raw material as it is carried through a barrel by a helical screw (Figure 6a). The pressure inside the barrel, and hence the yield of oil, are adjusted using a 'choke' ring at the outlet. The equipment has higher production rates than similar sized presses but is more expensive to buy and operate.

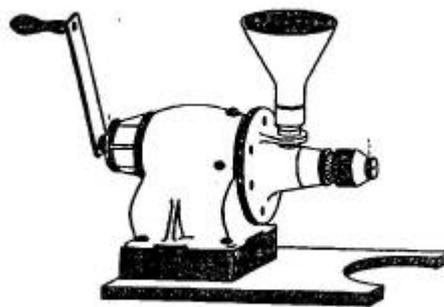
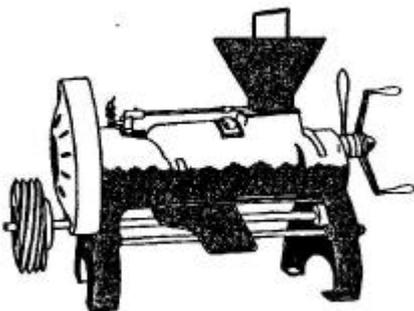


Figure 6a: Powered Oil Expeller

Figure 6b: Manual Oil Expeller

Although manual expellers are available (Figure 6b), small scale oil millers more often use powered equipment to reduce the time and labour involved in processing. Some designs also have an electric heater fitted to the barrel to increase the rate of oil extraction. The production rate using presses and ghanis depends on the size of the equipment and the time taken to fill, press and empty each batch. The production rate of expellers depends on the size of the equipment, the speed of the screw and the setting of the choke ring.

Clarification of oil

Crude (freshly extracted) oil contains moisture, and fibre, resins, colours etc. from the plant material, which make it darker and more opaque. These materials are removed by clarification – either by letting the oil stand undisturbed for a few days and then separating the upper layer, or by using a clarifier (Figure 7). This consists of an oil drum placed above a fire. The oil is boiled to drive off water and destroy naturally occurring enzymes and contaminating bacteria. The oil is allowed to stand and contaminants separate out. The oil is filtered through a cloth and heated briefly to 100°C to boil off any remaining traces of moisture. This is usually sufficient to meet the quality needs of customers and give a shelf life of several months when correctly packaged. However, the oil requires additional refining stages of de-gumming, neutralising and de-colouring to have a similar quality to commercially refined oils, and these stages are difficult to complete at a small scale.

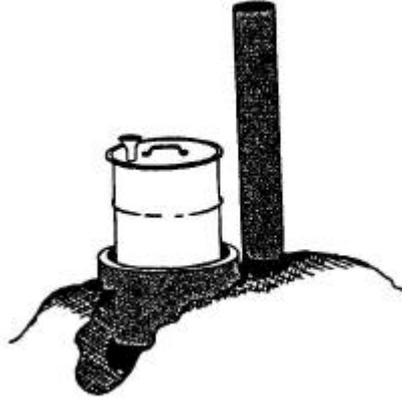


Figure 7: A Clarifier

Packaging and storage of oil

If incorrectly stored, some types of oil rapidly go rancid and develop an unpleasant odour and flavour. The main factors that cause rancidity (in addition to moisture, bacteria and enzymes above) are light, heat, air and some types of metals. To obtain a shelf life of several months, oils should be stored in lightproof, airtight and moisture-proof containers in a cool place. Tin coated cans, glazed pottery, coloured glass and certain types of plastics are each suitable when properly sealed. Great care is needed to remove all traces of oil from re-useable containers, and to thoroughly dry them before re-filling, because any residual moisture or rancid oil on the inside will rapidly spoil fresh oil. The materials used to make processing equipment and containers should not contain copper as it promotes rancidity. Stainless steel, galvanised iron, enamelled iron or aluminium are suitable.

Use of by-products

Coconut by-products (Figure 8) have a wide variety of uses. Groundnut meal is widely used for human food (biscuits, soups etc.) when it is extracted by manual methods which do not burn the by-product. Other fruits, nuts and oilseeds produce by-products that can be used for fuel and animal feeds (Table 1). The high temperatures employed in expellers burn by-products and they are only suitable for animal feeds. However, all oil extraction businesses need to identify markets for their by-products for economic viability.

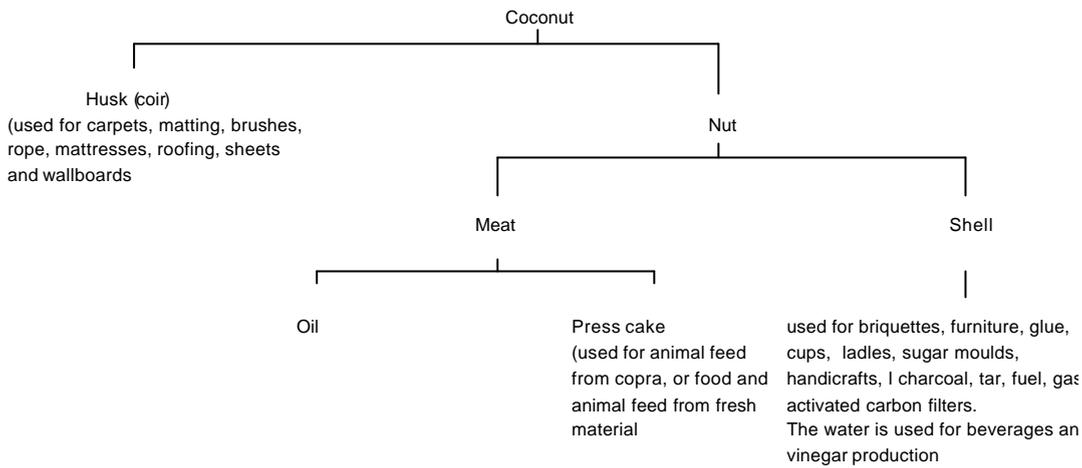


Figure 8: Coconut by Products

Quality assurance

The main quality checks concern raw materials, processing conditions, product quality and packaging and storage conditions. Raw materials should be checked to ensure that there is no mould growth, and that they are correctly dried, cleaned and sorted. During processing, the temperature and time of conditioning, the moisture content of the raw material, and the yield of oil should be routinely checked. Quality checks on the product include correct colour, flavour, odour, clarity and fill weight.

Oil processing as a business

The profitability of oil processing depends on reducing the capital and operating costs as much as possible, and at the same time maximising the income from the sale of oil and by-products. A careful study of all costs should be undertaken before setting up a production unit. In particular the cost of the main pieces of equipment, salaries for the expected number of workers, and the prices for raw materials, fuel and power should be assessed.

The price that can be charged for oil and by-products depends on a number of factors including quality, packaging, and the number, type and quality of competing products. These should each be assessed in order to calculate the likely income at the planned scale of production over the year. The production costs can then be compared with the expected income to calculate the likely profitability. In most cases it is necessary to make full use of the by-products to make the enterprise financially successful.

Different systems are used for marketing and selling oils and by-products, and it is necessary to select one that meets the needs of consumers, while at the same time keeping the costs of selling as low as possible. For example, contract (or custom) oil extraction, in which farmers or households bring their crop to the oil mill for processing, has the lowest selling costs. Alternatively, oil can be sold from bulk drums into customers’ containers in markets or at the production site, or it can be packaged into retail or bulk containers and transported to towns for sale. By-products are usually sold in bulk to poultry or animal producers, or to other food or animal feed processors. It may be advantageous to locate the oil mill in an area where by-products are needed in order to reduce transport costs.

One problem that faces oil processors is to ensure that there are adequate supplies of raw material to operate at the planned production rate throughout the year. It is likely that crops will be bought during harvest time when prices are lowest, but it may be necessary to offer an incentive for farmers to supply the processing unit, rather than sell on the open market. A simple contract to buy a specified amount of crop at a fixed price can benefit both farmers and processors, provided both parties keep their side of the agreement. Oil processors also need a large working capital to buy the year’s supply of seasonal crops, and adequate storage facilities so that they remain in good condition until they are processed.

technical brief

In summary, some questions to ask before setting up a small-scale oil extraction business are as follows:

- What is the local demand for oil and by-products?
- What is the existing level of competition?
- Are there enough oilseeds/nuts/fruit grown in the area for year-round work?
- Will you be able to buy it at an acceptable price, or is it already contracted to other producers?
- Will unrefined oil be acceptable to consumers?
- What price will they pay per litre of oil?
- What price can the by-products be sold for?
- What are the costs of packaging and distribution?
- Can you afford the cost of equipment without a loan?
- If a loan is needed to buy equipment and a year's supply of crop, how long will it take for the expected income cover the loan re-payments?
- Is the projected business economically viable?

In summary, ensure that a proper feasibility study is done before investing any money in an oil processing venture.

Equipment suppliers

Note: This is a selective list of suppliers and does not imply ITDG endorsement.

Decorticators

TROPIC
BP 706
Douala
Cameroon

Ubungo Farm Implements
Box 20126
Dar-es-Salaam
Tanzania

Zimplow Limited
HIS Steelworks Road
Box 1059
Bulawayo
Zimbabwe

Sismar
BP 3214
20 rue Dr.
Theze, Dakar
Senegal

ETSA Gaubert
22 rue Gambetta
BP 24
16700 Ruffec
France

Modern Engineering Company
1A Anna Street
Velandi Palayam
Coimbatore 641 025
Tamil Nadu India

SP Engineering Corporation
PB No 218
Kanpur 208 001
India

Gack Engineering
Tantra Hills, New Achimota,
Ant / B / 016 Accra,
P.O. Box 15883 Accra Ghana
Tel: (221) 21 404109/403744/403801

TAMSA Trading
152 Sidwell Avenue,
P.O. Box 14305,
6061 Port Elisabeth
SOUTH AFRICA
Tel: 27 41 43 339 /Fax: 27 41 411 731

Farm Implements Limited
Ubungo Industrial Area,
P.O. Box 20126
Dar Es Salaam
Tanzania
Tel: 255 51 43075/43259 /Fax: 255 51 43259

Cooperative des Ouvriers Metallurgiques de
Faranah (COMFAR) Quartier Aviation en face de
l'Aéroport de Faranah,
B.P. 11 Faranah / B.P. 2399 Conarky Faranah

RUTEC (PTY) LTD.
50 Davies Street,
P.O. Box 32011, 2017
Braamfontein Johannesburg

technical brief

Guinea
Tel: 224 41 20 88 / 41 20 98
Fax: 224 41 20 88

South Africa
Tel: 27 11 402 3245,
Fax: 27 11 402 3246

Mills/grinders

Sismar
BP 3214
20 rue Dr.
Theze, Dakar
Senegal

PACESL - Professional Agricultural Consultancy
and Expertise Services of Liberia
Vai Ioron, Bushwel Island,
P.O. Box 148, 1000 Monrovia
Liberia

Jyoti Limited
Bombay Shopping Centre
RC Duff Road
Vadodar 390 005
India

Ste Les Fils De Louis Samat
10 Boulevard De Freres-Godchot 13392
Marseille Cedex 4, France
Union Forgings Focal Point
Sherpur Ludhiana
Punjab India

Kirloskar Brothers Limited
Udyog Bhavan, Tilak Road
Pune 411002
India

Dandekar Brothers Engineers & Founders
Sangli-Shivaji Nagar
416 416 Maharashtra
India

Hindsons Pvt Limited
The Lower Mall
Patiala, 147001,
Punjab
India

Rajan Universal Exports
Post Bag 250
Madras 600001
India

CECOCO
P O Box 8
Ibaraki City
Osaka 567
Japan

Alvan Blanch Limited
Chelworth
Malmesbury, Wiltshire
SN16 9SG, UK

Presses and Expellers

Lutanda Limited
P O Box 20516
Kitwe
Zambia

Agrico Agricultural Engineers Limited
Kaneshie Industrial Area,
P.O.Box 12127 Accra-North
Ghana
Tel: 233 21 228 260/236 240/228 292
Fax: 233 21 230 481 /E-mail:
agrico@ncs.com.gh

Smallholder Agricultural Mechanisation Services
- SAMS
Woodlands, P/Bag W47 Lusaka
Zambia
Tel: 260 1 233 229 /Fax: 260 1 233 229

Tanroy Engineering (Pvt.) Ltd.
179 Loreley Crescent, off Mutare Road,
P.O. Box AY 382,
4 Amby, Msasa Harare Zimbabwe
Tel: 263 4 487791/3 /Fax: 263 4 487794

CGC Agricultural Service Ltd
No.1 Clarkson Street, SK 2591
Banjul

Fateco Ltd
Agbogba Village, 3 km. off Madina-Kwabanya
Road,

technical brief

Gambia
Tel: 220 222 254 /Fax: 220 222 254

TAMSA Trading
152 Sidwell Avenue,
P.O. Box 14305,
6061 Port Elisabeth
South Africa
Tel: 27 41 43 339 /Fax: 27 41 411 731

Rajan Universal Exports
Post Bag 250,
Madras 600 001
India

Tinytech Plants
Tagore Road
Rajkot 360 002
India

Traas Metaal BY
Groene Kruisstraat 3
Waarde (2)
Netherlands
Simon-Rosedowns Limited
Cannon Street
Hull, HU2 OAD, UK

Coconut oil equipment

Women's Revolutionary Socialist Movement HQ
44 Public Road
Kitty
Georgetown,
Guyana

Larkai Engineering
Community 7, P.O. Box 8388
Tema
Ghana
Tel: 233 22 206809
Fax: 233 22 206809

Agrico Agricultural Engineers Limited Kaneshie
Industrial Area,
P.O.Box 12127
Accra-North
Ghana
Tel: 233 21 228 260/236 240/228 292
Fax: 233 21 230 481
E-mail: agrico@ncs.com.gh

Palm/palm kernel oil equipment

P.O. Box 9899 KIA Airport, Accra Ghana
Tel: 233 663114/303029/502547

SP Engineering Corporation
PB No 218, 79/7 Latouche Road
Kanpur 208 001
India

Kisan Krishi Yantra Udyog
64 Moti Bhawan, Collectorganj
Kanpur 208 001
India

China National Agricultural Machinery Import and
Export Co-operation
26 South Yeutan Street
Beijing China

Gack Engineering
Tantra Hills, New Achimota,
Ant / B / 016 Accra,
P.O. Box 15883 Accra
Ghana
Tel: 221 21 404109/403744/403801

TAMSA Trading
152 Sidwell Avenue,
P.O. Box 14305,
6061 Port Elisabeth
South Africa
Tel: 27 41 43 339 /Fax: 27 41 411 731

technical brief

Agrico Agricultural Engineers Limited Kaneshie
Industrial Area,
P.O.Box 12127 Accra-North
Ghana
Tel: 233 21 228 260/236 240/228 292
Fax: 233 21 230 481
E-mail: agrico@ncs.com.gh

CGC Agricultural Service Limited
No.1 Clarkson Street, SK 2591
Banjul
Gambia
Tel: 220 222 254 /Fax: 220 222 254

KADDAI Engineering Enterprise
No. O.I. 89 Ashantt New Town,
P.O. Box 2268
Kumasi
Ghana
Tel: 233 51 20 492
Fax: 233 51 27 528

Nova-SOTECMA
Sarl Av. 1o Congresso do MPLA 24-26, C.P. 306
(Caixa postal)
Luanda
Angola
Tel: 244 2 330 343/5
Fax: 244 2 335 378

Shea butter equipment

Agrico Agricultural Engineers Limited Kaneshie
Industrial Area,
P.O.Box 12127 Accra-North
Ghana
Tel: 233 21 228 260/236 240/228 292
Fax: 233 21 230 481
E-mail: agrico@ncs.com.gh

Gack Engineering
Tantra Hills, New Achimota,
Ant / B / 016 Accra,
P.O. Box 15883 Accra
Ghana
Tel: 221 21 404109/403744/403801

RUTEK (PTY) LTD.
50 Davies Street,
P.O. Box 32011, 2017
Braamfontein Johannesburg
South Africa
Tel: 27 11 402 3245,
Fax: 27 11 4023246

Useful contacts and further information

Further information can be obtained from the following organisations:

- **ATI** (Appropriate Technology International), 1828 L Street NW, Suite 1000, Washington, D.C. 20036 USA. Tel: 202 293-4600, Fax: 202 293-4598. Has expertise and information on small scale oil extraction in Africa, particularly using manual Bielenberg Ram Presses. ATI - East and Southern Africa, 62 Livingston Avenue, Second Floor, New Haven House, Harare, ZIMBABWE, Tel: (263) 4704813 or 4704815, Fax: (263) 4704816, E-mail: mupunga@ati.icon.co.zw, Web site: <http://www.devcap.org/ati>
- **ATU**, Appropriate Technology Unit, Dept. of Community Development, Ministry of Local Government and Lands, 13 Marina Parade Banjul, GAMBIA, Tel: 220 228 178, Fax: 220 228 178. Has expertise in shea butter and coconut oil extraction and supplies equipment for both products.
CFTS Centre de Formation Technique Mgr. Steinmetz, Quartier Gbena, Route de Lome, sur la droite venant de Cotonou, B.P. Quidah, Atlantique Quidah, BENIN, Tel: 229 34 13 35. Has expertise in palm/palm kernel oil and supplies presses/expellers, palm/palm kernel equipment.
- **COMFAR** Cooperative des Ouvriers Metallurgiques de Faranah, Quartier Aviation en face de l'Aeroport de Faranah, B.P. 11 Faranah / B.P. 2399 Conarky Faranah, GUINEA, Tel: 224 41 20 88 / 41 20 98, Fax: 224 41 20 88. Has expertise in palm/palm kernel oil

technical brief

- extraction and supplies equipment.
- **CPTI** Centre Pilote de Technologie Industrielle, s/c Ministère de la Promotion du Secteur Prive, de l'Industrie et du Commerce, B.P. 468 Conakry, GUINEA, Tel: 224 46 26 95. Has expertise in shea butter and palm/palm kernel oil extraction and supplies equipment for both products.
 - **Department of Agricultural Engineering.** Egerton University, PO Box 536, Njoro, KENYA, Tel: 254-37-61620, Fax: 254-37-61442. Has expertise on oil extraction.
 - **D.T.E - C.I.** Materiel Agro-Industriel, 37, Rue de l'Industrie, Boulevard de Marseille, Zone 3, B.P. 18-629 Abidjan, CÔTE D'IVOIRE, Tel: 225 242666, Fax: 225 242688. Has expertise in shea butter extraction and supplies presses/expellers and shea butter equipment.
 - **FAKT** (Association for Appropriate Technologies in the Third World), Gaensheidestrasse 43, 7000 Stuttgart 1, GERMANY. Tel: 00 49 711 210950, 2109526, Fax: 0049-711-2109555, E-mail: Fakt_ger@comuserve.com. Has expertise in oil extraction from a wide variety of materials, information and assistance in project development.
 - **FAO**, Viale delle Terme di Caracalla, Rome 00100, ITALY. Has information on equipment and suppliers, publications and research/project reports of oilseed processing in developing countries (see website below).
 - **GRATIS** (Ghana Appropriate Technology Industrial Services), PO BOX 151, Tema, or PO BOX M 39., Accra GHANA, Tel: 0221 4243 or 00 221 42430, Fax: 00 221 6251/233 21 77488. Has expertise and information on palm oil, coconut oil and shea butter processing and supplies equipment.
 - **IDRC** 250 Albert St., Ottawa, K1G 3H9, Canada, www.idrc.ca. Has information and project activities in all types of oil processing.
 - **IITA**, International Institute for Tropical Agriculture, Post-Harvest Engineering Unit, Resource and Crop Management Division, PMB 5320, Oyo Road, Ibadan, NIGERIA, Tel: 234 2 241 2626, 234 22 400300/319 Fax: 234 2 241 222, 234 22 874 1772276, Email: iita@cgnet.com. Has information and expertise in all types of oil extraction, information on equipment suppliers and reports on oil extraction projects.
 - **ITDG** (Intermediate Technology Development Group), ZIMBABWE Office, 3rd Floor, Coal House, 17 Nelson Mandela Ave, Harare, Tel: 00 263 4 750880 Fax: 00 263 4 771030. Has information and expertise in establishing small scale sunflower and groundnut oil extraction enterprises.
 - **Nova-SOTECMA**, Sarl Av. 1o Congresso do MPLA 24-26, C.P. 306 (Caixa postal), Luanda, ANGOLA, Tel: 244 2 330 343/5, Fax: 244 2 335 378. Has expertise in palm/palm kernel oil extraction
 - **Oilseeds Development** 13 Upper High St., Thame, Oxon, OX9 3HL, UK. Tel: 44 (0) 1844 214153
 - **SAMeP** Smallholder Agricultural Mechanization Promotions (umbrella organization: AFRICARE) 87 Provident Street, P.O. Box 36658 Lusaka, ZAMBIA, Tel: 260 1 239 794/233 578, Fax: 260 1 235 665/226 406, Email: samep@zamnet.zm. Has expertise in shea butter extraction
 - **Technical Assistance** (Int), P O Box 1224, Vosskuhlenweg 2, Bargteheide, GERMANY. Has information on oil extraction.
 - **TEMDO** Tanzania Engineering & Manufacturing Design Organisation P.O. Box 6111 Arusha Tanzania, Tel: 255 57 8058/6220, Fax: 255 57 8318, E-mail: temdo@habari.co.tz. Has information on oil extraction and supplies presses/expellers.
 - **Unata**, GVD Heuvelstraat 131, 3140 Ramsel, BELGIUM, Tel: 00 32 16 56 1022. Has expertise in small scale oil extraction, information on processing and supplies presses, seed scorchers and other equipment.

The following publications describe oil extraction in more detail:

1. The Manual Screw Press for Small Scale Oil Extraction, K.H.Potts and K. Machell, 1993, IT Publications, 103-105 Southampton Row, London, WC1B 4HH, UK.
2. Post-Harvest Operations, Chapter 6: Oilseeds, O.G. Schmidt (Ed), 1989. International Development Research Centre (IDRC), 250 Albert St., Ottawa, K1G 3H9 Canada (available from FAO Publications, Viale delle Caracalla, 00100, Rome, Italy).

3. Oilseed Crops, E.A. Weiss, 2nd Edn., 1999, Iowa State University Press, 2121 State Avenue, Ames, Iowa, 50014-8300, USA
4. Ghani: a traditional method of oil processing in India, K.T. Achaya, 1993, FAO Publications.
5. Catalogue of Small Scale Processing Equipment, S Maneepun, IFRPD, Kasetsart University, Thailand (available from FAO Publications).
6. Small Scale food Processing - a guide to appropriate equipment, P.Fellows and A. Hampton, 1992, (2nd edition expected in 2002), IT Publications/CTA,
7. Quality Assurance for Small Rural Food Industries P.Fellows, B. Axtell & M. Dillon, 1995, Technical Bulletin 117, FAO Publications.
8. Review of the current state of screw expellers and strategies of its upgrading, Dietz, H.M, Metzler, R. and Zarate, C. 1990. FAKT-Association for Appropriate Technologies in the Third World, Gaensheidestrasse 43, 7000 Stuttgart 1, Germany.
9. Instruction Manual for the Construction and Use of a Hand Operated Wooden Groundnut Sheller Makoko, M.S. and Balaka, H.R. (1991). Farm Machinery Unit, Ministry of Agriculture, Department of Agricultural Research, Chitedze Agricultural Research Station, PO Box 158, Lilongwe, Malawi.
10. Starting a Small Food Processing Business, P.Fellows, E. Franco & W. Rios, 1996, IT Publications.

For producers who can obtain assistance from a small business advisory service or an international development agency that has access to the Internet, there are 100+ websites on soap making. Most are either commercial sites that sell essences, oils etc that can be added to soap, or home soapmakers sites that give recipes and information on how to make soaps. The following websites have useful information and good links to other sites:

- | | |
|--|--|
| www.fao.org/inpho | has details of oil processing equipment and manufacturers around the world. |
| www.fao.org/agris | has news of science research in developing countries, and access to science journals and FAO databases via its documentation centre. Also an Agric/Caris magazine. |
| www.iita.org | has publications and contacts for research and development of oilseeds in developing countries |
| www.oilseed.org | website of the National Institute of Oilseed Products, has an international membership of companies, including processors, equipment suppliers, importers and exporters. |
| www.idrc.ca | has publications and contacts for research and development of oilseeds in developing countries |
| www.undp.org/fi | has details of coconut oil production as part of a Small Enterprise Development programme. |