Fat and oil industry waste utilization

**Production of oil and fat**

**Processing**

Oilseeds are generally cleaned of foreign matter before dehulling. The kernels are ground to reduce size and cooked with steam, and the oil is extracted in a screw or hydraulic press. The pressed cake is flaked for later extraction of residual fat with solvents such as "food grade" hexane. Oil can be directly extracted with solvent from products which are low in oil content, that is, soybean, ricebran and corn germ.

**Oil Refining**

Refining produces an edible oil with characteristics that consumers desire such as bland flavour and odour, clear appearance, light colour, stability to oxidation and suitability for frying. Two main refining routes are alkaline refining and physical refining (steam stripping, distillativeneutralisation) which are used for removing the free fatty acids.

The classical alkaline refining method usually comprises the following steps:

**Step 1.**Degumming with water to remove the easily hydratable phospholipids and metals.

**Step 2.**Addition of a small amount of phosphoric or citric acid to convert the remaining non-hydralable phospholipids (Ca, Mg salts) into hydratable phospholipids.

**Step 3.**Neutralising of the free fatty acids with a slight excess of sodium hydroxide solution, followed by the washing out of soaps and hydrated phospholipids.

**Step 4.**Bleaching with natural or acid-activated clay minerals to adsorb colouring components and to decompose hydroperoxides.

**Step 5.**Deodorising to remove volatile components, mainly aldehydes and ketones, with low threshold values for detection by taste or smell.Deodorisation is essentially a steam distillation process carried out at low pressures (2-6 mbar) and elevated temperatures (180-220°C).

For some oils, such as sunflower oil or rice bran oil, a clear table product is obtained by a dewaxing step or crystallization of the wax esters at low temperature, followed by filtration or centrifugation.

**Hydrogenation**

Hydrogenation of edible oils and fats has been applied on a large scale since the beginning of this century. The process is carried out in a three-phase system (hydrogen gas, liquid oil and solid catalyst) at temperatures ranging from about 120°C to about 220ºC max. in the final stages of the reaction. The catalyst consists of small nickel crystallites supported by an inorganic oxide, usually silica or alumina. After the reaction, the catalyst is filtered off and any traces of residual nickel are removed in post-refining to a level of about 0.1 mg/kg or below.

**Oil Cakes and their biotechnological application**

Oil cakes/oil meals are by-products obtained after oil extraction from the seeds. Oil cakes are of two types, edible and non-edible. Edible oil cakes have a high nutritional value; especially have protein content ranging from 15 to 50%. Their composition varies depending on their variety, growing conditions and extraction methods. Due to their rich protein content, they are used as animal feed, especially for ruminants and fish. Non-edible oil cakes such as castor cake, karanga cake, neem cake are used as organic nitrogenous fertilizers, due to their N P K content. They protect the plants from soil nematodes, insects and parasites.

**Biotechnological application of oil cake**

Oil cakes have been widely used for the production of industrial enzymes, antibodies, biopesticides, vitamins and other biochemical. They have also been commonly used as feed supplement.

**1. Production of enzymes**

There are several reports describing production of various enzymes using oil cakes as a substrate in solid state fermentation (SSF), or as supplement to the production medium. Oil cakes are ideally suited nutrient support in SSF rendering both carbon and nitrogen sources, and reported to be good substrate for enzyme production using fungal species. The enzyme production could be further enhanced by optimization of physiological and biological conditions.

Lipase, α-amylase, phytase, protease and glutaminase are some of the enzymes produced using oil cake as nutrient source.

**2. Production of mushroom**

The supplementation of oil cakes with rice straw substrate colonized by the mushroom, *Pleurotussajor-caju* increased the mushroom yields between 50 and 100% compared to the unsupplemented substrate.

**3. Production of antibodies and biopesticides**

Oil cakes have also been reported for use in production of antibiotics and antimicrobials. Some examples are **daunorubicin** (a synthetic antibiotics that interfere with DNA synthesis and is used in the treatment of acute leukaemia), **clavulanic acid** (antibiotic useful for the treatment of number of bacterial infections) and **cephamycin** (similar to penicillin)

**4. Production of other biochemical**

Mould strains were used to grow on oil seeds in 1950 to synthesize thiamin. Two major strong antioxidants from fermented sesame oil cake (SOC) were purified and identified as known sesaminoltriglucoside and sesaminoldiglucoside.

**Other application**

**1. Preparation of protein hydrolysate**

Oil cakes such as SOC and MOC have been used as substitute for animal protein hydrolysates, used in the treatment of protein malnutrition.

**2. As feed source**

Used in rations of animals and fish.

**3. As energy source**

Used in biogas generation.

**4. As bio-control agent**

Oil seed cakes have been efficiently used against plant-parasitic nematodes and soil inhabiting fungi infesting mungbean and chickpea.