OIL INDUSTRY BY-PRODUCTS

- After the removal of oil from oilseeds the remaining protein rich product is called ‘meal’.
- **Processes to obtain oil from oilseeds**
- 1.Hydraulic press (ordinary press method)
- 2.Continuous press (Expeller method)
- 3.Solvent extraction method
  - Direct solvent extraction method
  - Pre-press solvent extraction method

Hydraulic Press Method

- Raw material
- Cleaning
- Grinding
- Rough grinding
- Dry or steam heat (90 minutes 103-110 ° C)
- Hydraulic presses (1 hour 65-75 ° C)

- Oil is separated and meal is grinded (5-10% oil)

Hydraulic Press Method

- Requires a lot of work force
- Not possible to remove all of the oil
- Not used most commonly

Continuous Press Method

- Raw material
- Cleaning
- Grinding
- Drying (Moisture content is reduced to 2% in 8 minutes; temperature ranges between 30 to 130C
- Steam expeller in softening vessel 10-15 min at 130C (softens the material)
- Expeller barrel (twisted press method; spiral rotation, pressure, heat 140-150C
- Oil is removed
- Meal with 4-5% oil content is cooled and grinded

Solvent extraction method

- **Oil removal using solvent extraction**
- Direct extraction: Direct processing of oilseeds (whose oil content is below 15%) with solvent
- Indirect extraction: pre-pressing of oilseeds (whose oil content is more than 15% i.e. sunflower, peanuts, linseed, rapeseed, cottonseed- ranging between 35-70% -Soybean oil content 20%)

  With pre-pressing the oil content is reduced to 10-12% and then material is processed through solvent extraction

Solvent extraction method

- Raw material
- Cleaning
- Grinding
- Heating (at 60C for 10 min)
- Making layers using crushing rollers
- Cooling up to 45C
- Extraction with the solvent
- Heating at 97C for 10 min (to separate solvent)
- Roasting at 104C for 90 minutes (to neutralize urease and trypsin inhibitors present in the soya)
- Cooling to 38C in 10-20 minutes
- Grinding
- Oil content in the obtained meal is below 1%

solvent

- Hexane
- Benzene
- Trichlorethylene
- carbon sulfide
- Acetone

- trichlorethylene
  internal bleeding in the animal

Hexane

- **Superiority over other solvents**
- Easy to recycle as compared to others
- Does not dissolve other fat-like substances (such as wax, pigments)
- Does not contain non-volatile toxic substances
- Can be used repeatedly
- The disadvantage of the hexane is that it is rapidly flameable material

Factors affecting the nutritional value of meal

- ***- Temperature***
- temperature ↑ → breakdown of amino acids ↑
- Protein utilization ↓
- ***- Heating time***
- Heating time ↑ protein utiliaztion ↓
- ***- Oil content in meal***
- From animal nutrition point of view the residual oil in meal
  - Energy source
  - Excessive oil casue oxidation and rancidity

Rancid Oil

- Has toxic effects
- Causes degradation of vitamins A, D, E and biotin
- Linoleic acid oxidation results in deficient unsaturated fatty acids
- Causes various digestive disorders in animals
- Due to unpleasant odor of oil feed consumption decreases; quality of products such as oil, meat and milk is deteriorated

Hull quantity in the meal

- Amount of hull in the meal ↑ → CF ↑
- Nutrient digestion ↓

General characteristics of meals

- 90% DM
- 30-50% CP
  - 95% of N is true protein
  - Protein digestibility, biological value ↑
- 9-20% CF
- 6-7% Ash
  - Calcium↓
  - P, K, Mg ↑
- ME
  - poultry 2000-2300 kcal/kg
  - ruminant 2200-2700 kcal/kg

Most commonly used meals in animal nutrition

- soybean meal
- sunflower meal
- cotton seed meal
- flax seed meal
- peanut meal
- sesame meal
- hazelnut meal
- Canola meal
- Poppy seed meal

Soybean Meal

- Protein biological value ↑
- Soyabean meal 44-50% CP
  - lysine↑
  - Low in methionine
- CF 4-7%
- Nutrient digestibility ↑ 90%
- EE 1%
- Ash 5-6%
  - Sufficient quantity of phosphorus (0.70%)
  - Calcium (0.30%) ↓

- B vitamins ↑
- A, C and D vitamins ↓
- ME
  - poultry 2550 kcal/kg
  - ruminant 2850 kcal/kg
- If insufficient heating
  - Urease and trypsin inhibitor in meal
- Determination of urease activity in the meal and then appropriate heat application

- High quality protein
  - Mostly used by the young animals and poultry
- In poultry rations up to 40%
  - (Methionine in the rations)
- Dairy cattle 2kg/day
- Beef cattle 1 kg/day
- Sheep 300 g/day
- Horse 1 kg/day

Sunflower Meal

- Quality depends on the hull amount present
- Whole seeds
  - Meal feeding value ↓
- CP 22-42%
  - Lysine ↓
  - Protein biological value ↑

Sunflower Meal

- Meal from dehulled sunflower seeds
  - CP 40-44%
  - Organic matter digestibility more than 80%
- Meal from the whole sunflower seeds
  - CP 22-25%
  - Organic matter digestibility 40%
- CF 14-28% (depending on hull quantity)
- Ash 6-7%
- EE 0.5-2% in solvent extracted meal while 4-7% in expeller meal
- ME
  - poultry 1900 kcal/kg
  - ruminant 2300 kcal/kg

Sunflower Meal

- Phosphorus and iron ↑
- Other minerals are present in medium quantity
- Readily consumed by the animals
- In poultry rations whole seed sunflower meal is not used
- In layer animal rations

  When used whole seed meal, it causes staining of egg shells (chlorogenic acid)

Sunflower Meal

- Dehulled meal
  - In layer animal rations 15%
  - In broiler rations 5%
- Dairy cattle 2 kg/day
- Beef cattle 1 kg/day
- Sheep 250 g/day
- In cattle compound feeds up to 30%

Cottonseed Meal

- CP 25-45%
  - Hull quantity
  - Processing method
  - Lysine, methionine, cystine, tryptophan ↓
  - Protein biological value ↓
- CF 10-20% (depends on hull quantity)
- EE (depends on processing technique)
  - solvent extraction 1-2%
  - Expeller 4-7%

Cottonseed Meal

- Ash 6-8%
  - P ↑ (0.70-1.30%)
  - Ca ↓ (0.20-0.30%)
- ME
  - Poultry 2000 kcal/kg
  - Ruminant 2500 kcal/kg
- Restricting factor for its usage
  - Gossypol

Cottonseed Meal

- Gossypol in cottonseed
  - Free and bound forms
- Free form
  - Causes toxic effects
- While processing seed to produce meal
  - Free gossypol
    - Some amount passes to oil
    - Some binds with lysine, so lysine utilization ↓
    - Some amount passes to the meal

Cottonseed Meal

- Cotton seed meal produced in Turkey
  - Free gossypol 0.05-0.07%
  - Bound gossypol 0.4-0.6%

Cottonseed Meal

- If poultry fed with cotton seed meal are high in gossypol, olive green colour will develop in egg yolk (because gossypol binds with the ferric form of the iron)
- In such situations, to the rations
  - Easily soluble iron sulfate is added
  - Thus, in the intestine iron-gossypol complex is formed
  - Which reduces the gossypol absorption
  - And reduces gossypol negative effects in the body

Cottonseed Meal

- Upper limits of gossypol in rations
  - Layer 40 ppm,
  - broilers 150 ppm

- For every 1 ppm free gossypol, iron sulphate can be added to rations of
  - Layers 4 ppm,
  - Broilers 1-2 ppm
- Upper limits
  - Layers 150-200 ppm,
  - broilers 400 ppm

- In layer rations 10 ppm of free gossypol is sufficient to change the yolk colour
- Fermentative action in the rumen of ruminant animals protects them from the negative effects of gossypol
- In high producing dairy cows rations presence of gossypol at high levels decreases the milk production. Critical level for free gossypol is 24g

- Other factors restricting the usage of cotton seed meal
  - Cyclopropane fatty acids
- The cyclopropane fatty acids found in the cotton seed oil are malvalic and sterculic acid.
- They cause pink coloration in the egg white and also result in excessive accumulation of stearic and palmitic acids in storage fats.
- In raw cottonseeds concentration of these acids is 0.6-1.2%
- In meal 0.01% (it depends on the residual oil content of the meal)

Cottonseed Meal

- In poultry rations 5-10%
  - it should be evaluated from protein, fat, cellulose and gossypol point of view
- To dairy cattle
  - Expeller meal 1 kg/day
  - Solvent extracted meal 2 kg/day
- If used expeller meal in large amounts
  - It negatively affects milk and butter quality
- Should not be given in high quantities to pregnant animals, otherwise abortion may occurs
- Beef cattle 1-2 kg/day
- Sheep 300 g/day
- Ruminant compound feeds 20%
- To horses 1 kg/day **(**along with oats**).** Excessive feeding causes digestive problems

Canola Meal

- Improved variety of rapeseed
  - Lower content of glucosinolates and erucic acid
  - **Canola**
- Composition of canola meal
  - Canola seed type
  - Processing method
- In solvent extracted meal
  - 38-46% CP
  - 1% EE
  - 11-13% CF
  - 8% Ash
  - ME
    - poultry 2100 kcal/kg
    - ruminant 2500 kcal/kg
- In poultry rations up to 20%

Biodiesel Industry By-Products

- Biodiesel and bioethanol

- Renewable energy sources for livestock and feed sector.

- In biodiesel production along with vegetable oils, animal fats and restaurant oil wastes, alcohol in the form of methanol and alkali catalysts (sodium hydroxide, potassium hydroxide) are preferred.

Glycerol

- Fatty acids in the form of Methyl or ethyl esters are obtained from biodiesel fuels, vegetable or animal fats and are used in diesel engines and heating systems.
- Glycerol is also obtained as a byproduct in biodiesel production.
- 1 Mol glycerol is obtained from every 3 Mol methyl esters. This comprises about 10% of the total product.

Glycerol

- Glycerol tri-hydric is an alcohol and has a colorless and odorless structure. Because of its hygroscopic properties, it is used as a moisturizer in cosmetics. Glycerol as a solvent is used in dynamite, cosmetics, liquid soap, ink and lubricant production; as an element of antifreeze mixtures glycerol is used in packaging materials, tobacco products, antibiotics, and as source of nutrients for fermentation cultures during pharmaceutical production.

- The calorific value of glycerol is
  4300 kcal / kg.
- For carbohydrates 4200 kcal/ kg
- For proteins 5600 kcal / kg
- For long chain fatty acids 9400 kcal / kg

The average NEL value of glycerol is 2300 kcal / kg.

Glycerol

- Especially during the transition period (3 weeks before birth and 3-4 weeks after birth) in high-producing milk cows, use of glycerol contributes to energy needs, prevents metabolic disorders such as fatty liver and ketosis, increases lactation performance.

Glycerol

- Glycerol is especially given to milk cows during the transition period by pouring on feed 300-500 g/day or by adding to mixed feed.
- To cattle (dairy/beef) compound feeds up to 10%
- Beef cattle rations up to 10% glycerol
- Using in small amounts increases the pellet quality.
- Poultry rations 10%

Bioethanol industry By-Products

- Bioethanol is an alternative fuel for conventional combustion-ignition engines.
- The raw materials used in bioethanol industry include cereal grains (corn, wheat, sorghum, barley, rye, oats, rice), potatoes, sugar beet, sugar cane and wood and forages alike cellulose-rich feeds.
- For this purpose, mostly cereal grains are used.
- Products are presented as alcohol distillation products