Chapter - V

FATS
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5.0 Fats

5.1 Introduction

Fats are non-polar, water insoluble triesters of fatty acids and glycerol. They are the substances of biological origin that are soluble in organic solvents such as chloroform and methanol but, are sparingly soluble, if at all, in water. Hence, it could be easily separated other biological material by extraction into organic solvents and further be fractionated by techniques like adsorption chromatography, thin layer chromatography and reverse chromatography (Biochemistry, 2nd Edition, Donald Voet, Judith, G. Voet, 1996). It is formed intracellular, possibly in association with cytoplasm particles (Steiner and Heineman, 1954).

The term fats and oil are synonymously used by some because of its chemical resemblances with the only difference that fats are solid and oils are liquid at room temperature. Both of them are known as triglycerols. The reason behind the solid and liquid nature of fat and oil is that the fatty acid components of fat oil are predominantly of saturated and unsaturated fatty acids respectively. So plants generally have oil predominantly unsaturated fatty acid components and animal fats with saturated fatty acid component at the lower melting points of oils imply.

Fats are highly efficient form in which to store metabolic energy because of the fact that they are less oxidized than are carbohydrates and proteins, and hence yield significantly more energy on oxidation. Furthermore, fats being non-polar substances are stored in anhydrous form, where glycogen, for example, binds about twice its weight of water under physiological conditions. Fats,
therefore provided about six times the metabolic energy of an equal weight of hydrated glycogen.

In animals, the synthesis and storage of tri-glycerols is done by the specialized cells called adipocytes. Adipose tissue is most abundant in a subcutaneous layer and in the abdominal easily. The fat content of normal human's (21% for men, 26% for women) enables them to survive starvation for 2 to 3 months. In contrast, the body's glycogen supply, which functions as a short-term energy store, can provide for the body's metabolic needs for less than a day. The hump of *Camellus bacterianus* and *C. domesticus* is a large adipose tissue that helps during starvation while roaming in desert for a month long journey. The subcutaneous fat layer also provide thermal insulation, which is particularly important for warm-blooded aquatic animals, such as Whales, Seals, Zeases and Penguins, which routinely exposed to low temperature.

It also serves as an electrical insulator allowing rapid propagation of depolarization wave along myclinated nerves. It provides essential fatty acids or poly unsaturated fatty acids and facilitates the absorption of the fat soluble vitamins A, D, E and K. It also provides support to internal organs like, heart, kidney and intestine. Fat is said to be protein sparing because its availability reduces the need to burn protein for energy. Excess of protein and carbohydrates are also changes into fats.

Most plant fats are completely oxidized into carbon dioxide and water during metabolic process (Thomas, 1960). There is transformation of carbohydrates into the formation of fats in plants (Caskey and Gallup, 1931). In fact, rather than being completely oxidized, it is converted into carbohydrates (Beavers, 1980). The most important single factor in fat formation is the
concentration of carbohydrates, more accurately the Carbon:Nitrogen ratio (Reuevus, 1948).

5.2 Materials and Methods

For the estimation of fat content A.O.A.C. Leslie (Association of Official Agricultural Chemists) method was used is mentioned by Leslei Hart and Fisher (1971).

An amount of 1 gm. of oven dried and powdered sample materials were transferred to Whatman No. 1 filter paper with a porosity permitting rapid flow of petroleum ether 60-80°C depending on the type of petroleum ether. The weight of the sample together with the dried Whatman No. 1 filter paper and the weight of the dry Soxhlet flask were recorded. The fat content of the samples were extracted using soxhlet's extract for 12 hrs. using petroleum ether as solvent for fats. The ether was then removed from the mixture by Cautions evaporation of the Soxhlet's flask in an oven at 100°C for 30 min., the extracted fat were left behind in the flask. The flask then cooled and weight again. The final weight of the sample and the filter paper were also recorded again.

\[
\text{Fat content} = (\text{Initial weight of the sample and the filter paper}) - (\text{Final weight of the sample and filter paper})
\]

Or

\[
\text{Weight of the flask with the extracted fat} - \text{weight of the flask without the extracted fat}
\]

5.3 Results and Discussion

From the above experiment it is known that the amount of fat content is highest in the tender shoot of Primula sp. (1.40 g/10g dry wt.) and the lowest is
noticed in rhizome of *Houttuynia cordata* (0.34 g/10g dry wt.). Similar amount of fat content is noticed in inflorescence of *Wendlandia glabrata* (1.01 g/10g dry wt.) and aril of *Euryale ferox* (1.02 g/10g dry wt.). Yet, other similar fat contents are the tuber of *Cyperus esculentus* (0.48 g/10g dry wt.) and roots of *Allium hookeri* (0.49 g/10g dry wt.). Amount of fat content in the leaf (0.82 g/10g dry wt.) is higher than that of the root of *Allium hookeri* (0.49g/10g dry wt.). Fat content in tuber (0.64 g/10g dry wt.) and shoot (0.74 g/10g dry wt.) were comparatively lesser than the other plants.

Trembcay (1989) studied the impact of dietary fat content and fat oxidation on energy intact in human and indicates that the high fat diet induces a short-term hyperphagia. A high percentage of lipids in the usual diet is alternate or amplify the high fat diet induced hyperphagia, depending on the magnitude of the exercise induced increased in fat oxidation.

Gracia *et al.* (1987) studied on the weight variation depending on the origin and level of fat in the diet and reported that significant improvement of growth index with 15% soya and 25% with olive oil.

Fat facilitates the absorption of fat soluble vitamins A, D, E and K and also helps in supporting the internal organs.

Fats act as an important source of storage energy in our body as it cannot be oxidized easily unlike carbohydrates, which get oxidized easily. Besides, the physiological fuel value of 1g of carbohydrates and proteins are 4 kcal. each, while the physiological fuel value of 1g of fats is 9 kcal.

There is transformation of carbohydrates to fats in plants (*Casky and Gallup, 1931; Sahasrabudhe and Kale, 1933; Thor and Smith, 1935*). Fat rather than being completely oxidized, it is converted to carbohydrates (*Beevers, 1980*).
The most important factor of fat formation is carbohydrates, more specifically carbon : nitrogen ratio (Raveus, 1948).

The intact of animal fat is risky as the amount of cholesterol is high in the saturated fats of animal origin that could lead to high blood pressure and other related cardio-vascular disorders. However, the plant fats are unsaturated fats and are completely oxidized to carbon dioxide and water during metabolic process (Thomas, 1960).

From the above experiment it can be concluded that green tender shoots of *Primula* sp. with a high vitamin C is having the highest fat content among the seven selected plants for the analysis. Hence, it could be recommended as a good source of fat avoiding the risk of taking animal fats.

Table No. 3. Comparative account of fat content in various different plant parts of the materials. Amount expressed in g/10g, dry wt. of the sample. The values are the mean of triplicates after 12 hrs. of siphoning

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Scientific Name</th>
<th>Local Name</th>
<th>Family</th>
<th>Plant Part</th>
<th>Amount of fat in g/10g (dry wt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><em>Cyperus esculentus</em> L.</td>
<td>Kaothum</td>
<td>Cyperaceae</td>
<td>Tuber</td>
<td>0.48</td>
</tr>
<tr>
<td>2.</td>
<td><em>Houttuynia cordata</em> Thunb.</td>
<td>Tokningkok</td>
<td>Saururaceae</td>
<td>Underground stem</td>
<td>0.34</td>
</tr>
<tr>
<td>3.</td>
<td><em>Primula</em> sp. L.</td>
<td>Kungoi</td>
<td>Primulaceae</td>
<td>Tender shoots</td>
<td>1.40</td>
</tr>
<tr>
<td>4.</td>
<td><em>Allium hookerii</em> L.</td>
<td>Napakpi</td>
<td>Liliaceae</td>
<td>Leaves</td>
<td>0.49</td>
</tr>
<tr>
<td>5.</td>
<td><em>Wendlandia glabrata</em> (Roxb.) DC.</td>
<td>Feija</td>
<td>Rubiaceae</td>
<td>Inflorescence</td>
<td>1.01</td>
</tr>
<tr>
<td>6.</td>
<td><em>Sagittaria sagittifolia</em> L.</td>
<td>Kaukha</td>
<td>Alismataceae</td>
<td>Tuber</td>
<td>0.64</td>
</tr>
<tr>
<td>7.</td>
<td><em>Euryale ferox</em> Salibs.</td>
<td>Thangjing</td>
<td>Nymphaeaceae</td>
<td>Shoot</td>
<td>0.74</td>
</tr>
</tbody>
</table>

Note – S.D. - 0.30, S.E. – ±0.10, C.D. – for 1% - 0.15, C.D. for 5% - 0.10
Comparative Accounts of Fat Contents

Various parts of the seven selected typical food plants

Index of Plants

1. *Cyperus esculentus* Linn. (Tuber),
2. *Houttuynia cordata* Thunb.(Rhizome),
3. *Primula sp.* (Shoot),
4. *Wendlandia glabrata* D.C. (Inflorescence),
5. *Allium hookerii* Linn. (Leaf),
6. *A. hookerii* Linn.(Root),
7. *Euryale ferox* Salisb. (Endosperm),
8. *Euryale ferox* Salisb. (Aril),
9. *Sagittaria sagittifolia* Linn (Tuber),
10. *Sagittaria sagittifolia* Linn (Shoot).