CHAPTER-IV

Studies on Phyllanthus emblica Seed Fat
Chocolate has the largest market among confections. *Theobroma cacao* (Sterculiaceae) fat — known as cocoa butter is predominantly used in chocolate making.\(^1\) The fat from the seed (contained in beans) consists of triglycerides containing palmitic, stearic and oleic acids. The plantation is costly and the plant is mainly restricted to Southern India. As an alternative source — *Phyllanthus emblica* (Euphorbiaceae) seed fat has been tried in the present work. Though the fatty acid composition of *Phyllanthus emblica* seed fat is not exactly similar to cocoa — it has a favourable saturated/unsaturated fatty acid composition along with presence of two more essential fatty acids. Its non-toxicity and nutritional compatibility may favour its edible attributes.

It is available locally with appreciable yield of fat. The detailed physico-chemical and nutritional studies have earlier been carried in this Laboratory.\(^2,3\)

**A. Seed fat profile**

*Phyllanthus emblica* or *Emblica officinalis* (Euphorbiaceae) is a medium-sized tree with spreading branches, found in Central and Southern India.\(^4\) High amount of ascorbic acid, in the fruit, has been reported.\(^5\)
Studies on physico-chemical composition under Konkan agro climatic conditions have recently been studied.\(^6\) Nitric oxide radical scavenging active components from the species have also been reported.\(^7\)

*Phyllanthus emblica* seeds were collected locally and identified at the Botany Department of this University. The fat from the coarse seeds was extracted with petroleum ether (40 – 60\(^0\)C) in a Soxhlet extractor. After determination of the physical properties, the fat was saponified in presence of alkali. The saponified mixed fatty acids were converted to fatty acid methyl esters (FAME) using methanol/H\(_2\)SO\(_4\). The ester was preliminary analysed by TLC taking diethyl ether : hexane : acetic acid (20 : 80 :1) as solvent system and charring at 120\(^0\)C for detection and finally by GLC (Varian – Vista 6000) with OV 101 column, N\(_2\) carrier gas, F. I. D. using 1µl sample and a chart speed of 4 mm/min.

For testing hardness of the fat, it was pulverised taken at 60\(^0\)C (molten state) and rapidly cooled to 0\(^0\)C on Differential Scanning Calorimeter – DSC (Seiko 580) head.
Fig. IV/A1: GLC profile of seed oil (P. emblica)
Results and Discussion

The seeds of *Phyllanthus emblica* contain 22% fat content.

Some of the physical properties are:

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
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<tr>
<td>Refractive index</td>
<td>1.4580</td>
</tr>
<tr>
<td>Free fatty acid (FFA) content</td>
<td>1.20%</td>
</tr>
<tr>
<td>Iodine value</td>
<td>36.86</td>
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<tr>
<td>Saponification value</td>
<td>195.75</td>
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*Fig. IV/A1* shows the GLC profile of constituent fatty acids (as esters). Peak 1 could not identified. Peak 2 Myristic (14:0) 15.7%, Peak 3 Palmitic (16:0) 1.7%, Peak 4 Palmitoleic (16:1) 1.7%, Peak 5 Stearic acid (18:0) 19.3%, Peak 6 Oleic (18:1) 16.8%, Peak 7 Linoleic (18:2) 15.5%, Peak 8 Linolenic (18:3) 18.6% and Peak 9 Arachidonic (20:4) 3.2%.
Fig. IV/A2: DSC profile – Pulverised fat after tempering
Fig. IV/A2 depicts the DSC profile of the pulverised fat after tempering (rapid cooling of the molten sample) on DSC head and subsequent scanning (0°-50°C). The rapid cooling resulted in crystallization of the sample (I) which has a transformation to perhaps more stable form (II).

The events may be regarded as part of a process from pre-crystallization (0°C) to crystallization in metastable state at 17°C (maxima I) which subsequently changes to stable state at 21°C (maxima II). The findings could be of use in evaluating the hardness of the sample. These polymorphic forms show the initiation of crystal formation and may be useful for the later stage of bulk crystallization.

Solidification characteristics influence the physical properties of the finished product. The seed fat has different composition of fatty acids than cocoa fat and it contains two essential fatty acids. The properties are comparable with cocoa fat e.g. it is hard at room temperature and melts below body temperature. The fat may be regarded as a cocoa butter substitute but not cocoa butter equivalent.
Fig. IV/B1 (a): SEM profile of chocolate
B. Chocolate making using the fat

The seed fat of *Phyllanthus emblica* may not be totally compatible with cocoa fat due to change in individual fatty acids. To have proper softening and bloom in the chocolate made out of this fat, chocolate liquor (obtained from local confectionary), Laboratory grade sugar and lecithin as emulsifier has been added.

Experimental

*Phyllanthus emblica* fat 25%, Chocolate liquor 30%, Sucrose (A.R.) 40%, and Soya lecithin (Sigma) 1% (all by weight) were pulverized. The sample was observed under Scanning Electron Microscope – SEM (FEI – Philips XL – 30).

The above prepared chocolate was taken to a temperature of 60°C (molten) and later cooled at 20°C (tempering). At this stage, 5% (by weight) of Distearoyl (1,3) oleoyl (2) glycerol (Sigma) was added and the contents agitated for 5 minutes so as to disperse it in the molten chocolate. After 15 minutes, the sample was subjected to SEM and DSC.

Results and Discussion

SEM profile of Chocolate is shown in Fig. IV/B1(a) which shows a smooth surface. Although the seed fat prepared chocolate melts at around 35°C, the temperature is raised to 60°C and then rapidly decreased – for tempering. Distearoyl oleoyl glycerol known as seed material is used for bloom.
Fig. IV/B1 (b) : SEM profile of chocolate after addition of seeding material
After addition of seeding material, another SEM profile was taken [Fig. IV/B1(b)] which shows rough surface with irregular slates due to blooming.
Fig. IV/B2: DSC profile of chocolate after addition of seeding material
The DSC profile of the sample with seeding material (Fig. IV/B2) shows two endothermic peaks – the first corresponding to unstable form and the second to melting.
Fig. IV/B3: DSC profile of chocolate-2 days after addition of seeding material
The same sample, two days after addition of seeding material- shows a DSC profile with one endothermic peak (Fig. IV/B3) corresponding to melting, with disappearance of the unstable form. Thus during blooming, large crystals of more stable polymorph remains. The bloom may have been induced by the later addition of 5% Distearoyl oleoyl glycerol. The molecules that are incorporated into the large growing crystals may have been provided from less stable polymorph. The solute may migrate through oil fraction having low melting point.\(^{8,9}\)

The later addition of fat (Distearoyl oleoyl glycerol) may be termed as a seed material necessary to enhance crystallisation (blooming). Due to this process, many crystal pieces are formed – may be due to crystal – crystal agitation or stress of crystal melt suspension caused by agitation. Careful control of solidification process may influence gloss, texture and stability of final product.
REFERENCES


