Processing of Cocoa Butter Equivalent by Dry or Acetone Fractionation of Sal and Shea Butters and its Techno-economic Feasibility

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Shorea robusta, commonly known as Sal, belongs to the Dipterocarpaceae family. Sal is an important non-timber forest product (NTFP) and it is available in many South Asian countries like India, Pakistan, Nepal etc. Sal fat can be converted to sal stearin and sal oleine by dry or solvent fractionation through a highly guarded process technology. The dry fractionation technology's investment cost is very low (Rs 4 to 6 core) for a 10 TPD dry batch fractionation plant. This gives lower yield of stearin and quality with respect to acetone fractionation plant where investment cost may be little higher (Rs 22 to 25 cores) for a 20 to 25 TPD acetone fractionation plant. In case of solvent fractionation plant, the yield of stearin is much higher around 65% with a better quality of NMR values at 35 and 40°C to be used for Cocoa Butter Equivalent (CBE).

The same solvent fractionation plant can be used for preparation of shea stearine from shea butter and Hard palm mid fraction (HPMF) from palm mid fraction which are important component for CBE. This plant can also be used for making CBS (Cocoa Butter Substitute) from palm kernel oil by solvent fractionation.

According to Custom Market Insights (CMI), the Global Shea Butter Market which was estimated at USD 2.5 billion in 2021 reached USD 2.8 billion in 2022 and is anticipated to reach around USD 5.2 billion by 2030, growing at a CAGR of roughly 8% between 2022 and 2030. Shea fat is considered to be a valuable raw material for the preparation of confectionery fat by modification through solvent fractionation - this is a highly guarded process technology and not present in public domain. It is a feasible project with minimum pay back period. Shea butter has a very unique composition of isoprenoid lipid which is present in it as unsaponifiable matter.

It is required to remove gums from the oil by acetone degumming process before it is subjected to acetone fractionation for making shea stearin and shea oleine. This process involves initially the removal of about 4 to 6% undesirable unsaponifiable matters of Shea butter containing isoprene gums which affects the crystallization of shea butter for making shea stearin by acetone crystallization. This is done at elevated temperatures and with a particular oil : acetone solvent ratio and retention time at which condition only these unsaponifiable matters is crystallized and gets separated from the miscella. The miscella separated from gums is then subjected to further crystallization with optimum oil : solvent ratio, temperature and retention time to give suitable products with proper physico-chemical characteristics in respect of NMR values at different temperatures mainly at 35°C more than 65 and 40°C between 1-4 units as minimum requirements, triglyceride compositions having SOS content more than 85 to 90% minimum and about 40% yields.The quality and yield of shea stearin depends on optimum parameters of fractionation and quality of shea butter. The FFA of the crude shea butter along with its mono and diglyceride content and colour component is migrated towards the oleine side leaving shea stearin with lower ffa, color and lesser diglyceride content during this acetone fractionation due to the high

polarity of acetone. The crude stearine and crude oliene obtained after distillation of crude stearin miscella and crude oleine miscella due to this acetone fractionation is finally refined to give the refined stearin which can be used as CBE and refined shea olein to be used as margarine base and also as direct cooking oil.

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All the above mentioned process technology both from sal fat and shea butter for making CBE which is not present in public domain will be presented in detail for the making of CBE by dry and acetone fractionation through proper process flow diagram supported by established R&D data. This will give quality CBE with highest yield proper physic chemical properties to make it economical. The ROI of these projects for making CBE from exotic fats like sal and shea butter will be discussed.