PRODUCTION OF INDIVIDUAL CAROTENE, TOCOLS AND CHOLESTEROL-FREE STEROL FROM CRUDE PALM OIL

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Crude palm oil consists of 1% phytonutrients namely the carotenes, vitamin E; tocols (tocopherols and tocotrienols), squalene and sterols (Goh *et al.*, 1985). These phytonutrients have gained considerable importance as they exhibit properties that allow them to have a promising future in pharmaceuticals, nutraceuticals as well as cosmetics industries. The individual carotenes, tocols and sterols in their more refined forms can also be utilized as fine chemicals or standard reference chemicals.

Fine chemicals are high purity compounds that can be used as standard reference materials in research and development work. These standard reference materials are of high economic value as they are in a very refined form with high purity. Besides, the individual carotenes, tocols and sterol are also important ingredients in pharmaceuticals, nutraceuticals, cosmetics as well as food industries. In view of their economic value, a process has been developed to produce these fine chemicals from crude palm oil.

PRODUCTION TECHNOLOGY

The process for the production of fine chemicals from crude palm oil consists of purification of phytonutrients using supercritical fluid chromatography (SFC) or flash chromatography.

The last stage of the process involves the separation of the individual carotene, namely, phytoene, phytofluene, α-carotene, β-carotene and lycopene; tocols isomers namely, α-tocopherol (α-T), α-tocotrienol (α-T_3), γ-tocopherol (γ-T), γ-tocotrienol (γ-T_3) and δ-tocotrienol (δ-T_3) as well as β-sitosterol using supercritical fluid chromatography (SFC). An important feature in this process compared to conventional chromatography is that supercritical carbon dioxide (SC-CO_2) which is clean and non-hazardous is used as the eluting medium. The fine chemicals produced from SFC are more than 95% pure.

ADVANTAGES OF THE PROCESS

1. High purity individual carotenes namely, phytoene, α-carotene, β-carotene and lycopene; tocol isomers, (the tocopherols and tocotrienols) as well as β-sitosterol are valuable phytonutrients, fine chemicals and standard reference chemicals.
2. The supercritical fluid (*i.e.* supercritical carbon dioxide) used as solvent in the production of these fine chemicals is non-toxic, non-hazardous, non-inflammable and environmentally friendly. Most importantly, it leaves no *solvent* residue in the products.
3. Minimal organic solvents are used in the process.
4. The high selectivity of the supercritical fluid enables the production of these high valued fine chemicals.
5. This process incurs very low operating cost.

APPLICATIONS OF INDIVIDUAL CAROTENES, TOCOLS AND STEROL

Individual palm carotenes, tocols and sterols produced can be used as fine chemicals or standard reference materials in research and development work where high purity compounds are needed for analytical references as well as identifications. Commercial laboratories are also in need of such standard reference chemicals for quantitations and analytical work.

Another application of individual palm carotenes is in the pharmaceutical industry where they are made into health supplements. Lycopene, which is known for its anticancer property is useful to the food industry where it is a value-added ingredient in fruit juices such as tomato juice.

The palm tocol isomers (α-T, α-T_3, γ-T, γ-T_3 and δ-T_3) are known for their antioxidant properties which make them popular ingredients in pharmaceuticals, cosmetics formulations and health supplements.

The β-sitosterol has attracted considerable interest among nutritionists as it exhibits hypocholesterolemic (cholesterol lowering) property. It is commonly used in food industry for low-cholesterol products such as low-choletesterol margarine. In pharmaceuticals, β-sitosterol is used to produce steroid derivatives.

CONCLUSION

This novel process is able to produce fine chemicals and high purity vitamins, namely phytoene, α-carotene, β-carotene, tocopherols and tocotrienols isomers as well as β-sitosterol from crude palm oil.

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Crude palm oil (CPO)

CPO Alkyl Esters

Glycerol

Phytonutrient concentrate

Individual carotene:
Lycopene, Phytoene,
α-carotene, β-carotene

Tocols isomers:
α-T, α-T_3, γ-T, γ-T_3, δ-T_3

β-sitosterol

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