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Popular Article

Oil Palm By-Products Utilization in Development of Non-Edible Products

Sanganamoni Shivashankar, K Suresh, P Anitha and A Sathish
ICAR- Indian Institute of Oil Palm Research, Pedavegi, Eluru, Andhra Pradesh – 534 435.
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Summary

Oil palm is a perennial oil crop, which produces high oil yield compared to other vegetable oils. Oil palm is valuable not just for cooking oil and food products, but also for non-edible products such as pharmaceuticals, cosmetics, and oleochemical industries. Oil palm also produces a lot of biomasses apart from high oil yield which is well known as renewable energy source that can be used to develop non-edible commercial products.

Introduction

Oil palm (*Elaeis guineensis* Jacq.) is the highest oil-yielding perennial vegetable oil crop, which yields approximately 5 tons of oil per hectare in a year. This crop is commercially grown in many countries in the world *viz.*, Africa, Malaysia, Indonesia, South America, and India. India is one of the major consumers of edible oil in the world and the major portion of edible oil is being imported from other countries. Oil palm cultivation gained prominence due to its high oil yield ability, which makes India self-sufficient in edible oil production. So far, an area of 3.69 lakh ha has been covered under oil palm cultivation with fruiting area of 1.89 lakh ha. Palm oil production in India during 2020-21 is recorded as 0.29 million tonnes, of which the state of Andhra Pradesh alone contributed about 83.32% to palm oil production. The cultivation of oil palm has a significant economic impact in increasing nation's GDP and employment generation in rural areas. Oil palm fruit yields two types of oil, crude palm oil (CPO) and palm kernel oil (PKO). Palm oil contains an equal amount of unsaturated and saturated fatty acids; this property is unique among all vegetable oils and fats. About 50% of its composition is made up of saturated fats, primarily palmitic acid (44%), with smaller amounts of stearic acid and myristic acid. The remaining 50%

comprises unsaturated fats, including oleic acid (a monounsaturated fat) and linoleic acid (a polyunsaturated fat). This balance of saturated and unsaturated fats contributes to palm oil's stability, versatility, and its ability to give products a longer shelf life. This ability to stabilize and extend the shelf life of most of the products made it a promising source as an ingredient in food, pharmaceuticals, cosmetics and oleochemical industries. The oil palm industry (plantation and milling) generates large amounts of solid waste in the form of empty fruit bunches, palm kernel shells, mesocarp fiber, oil palm fronds, and oil palm trunks. This leftover waste is collectively termed oil palm biomass (OPB) which is a well-known renewable energy source to produce value-added products such as methane gas, bio-plastic, organic acids, bio-compost, plywood, activated carbon, and animal feedstock. Oil palm is valuable not just for its high oil output, but also for the byproducts it produces. Oil palm industries producing lot of waste after extracting oil and this waste ac be utilized to produce some commercial products.

Palm Oil and Oil Palm By-Products Utilisation in Development of Non-edible Products

Oleochemicals

Oleochemicals are chemicals derived from plant or animal oils and fats. They are analogues to petrochemicals derived from petroleum. Palm oil and palm kernel oil have become important raw materials to produce such basic oleochemicals as fatty acids, fatty esters, fatty alcohols, and glycerols. The major uses of oleochemicals are in manufacture of non-food products like soaps, detergents and greases, printing ink, and biodiesel. Oleochemicals can substitute petrochemicals in most areas of applications. The advantage of oleochemicals over petrochemicals is that petrochemicals are renewable and more biodegradable. Crude palm oil based oleochemical derivative products include methyl ester, plastics, textile processing, metal processing, lubricants, emulsions, detergents, glycerine, cosmetics, explosives, pharmaceutical products, and food protective coatings. Oleochemicals can substitute petrochemicals in most areas of applications. The advantage of oleochemicals over petrochemicals is that oleochemicals are renewable and more biodegradable.

Surfactants

Surfactants are chemical compounds that decrease the surface tension or interfacial tension between two liquids, a liquid and a gas, or a liquid and a solid. Surfactants may function as emulsifiers, wetting agents, detergents, foaming agents, or dispersants. The word "surfactant" is a blend of surface-active agent. Petroleum-based surfactant has been used to overcome many problems causing reduced production in the petroleum production process.

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Fig. 1. Oleochemical derivative products

These include limited oil recovery, wax deposit, asphaltene deposit, sludge deposit, and emulsion problem. Therefore, innovation to solve these problems using surfactant containing natural materials deserves to be developed. Palm oil-based surfactant is one of the potential alternatives for this. Various types of derivative products of palm oil-based surfactants have been developed to be used in handling problems including surfactant flooding, well stimulation, asphaltene dissolver, well cleaning, and wax removal found in oil and gas industry.

Fig. 2. Oil palm-based surfactants

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Cosmetics and personal care products

Cosmetics and personal care products can be divided into four main categories: skin care, color cosmetics, hair care, and oral care products. The functions of skin care products are to clean, nourish, moisturize, stimulate, and protect the largest and most important organ of the human body which is the skin. Natural ingredients such as glycerine, fatty acids (lauric, myristic, palmitic, and stearic acids), fatty alcohols, and their esters can be used to replace synthetic ingredients. The total amount of natural-based ingredients incorporated in formulations can range from 45 to 98%. To increase the topical therapeutic properties of cosmetic products with unique functional properties, bioactives are added into cosmetic formulation. Some of the common bioactive ingredients used are vitamins, plant extracts, and sunscreen agents. Vitamin E is one of the most important phytonutrients found in palm oil. It contains both tocopherols (20-30%) and tocotrienols (70-80%). Tocopherols and tocotrienols are excellent antioxidants. These palm-based bio-actives such as tocotrienols rich fraction (TRF) with and without carotenes are available commercially. Tocotrienols are a much more potent antioxidant than tocopherols. Studies have shown that the administration of palm tocotrienol complex to animals results in a reduction of oxidative stress risks and, therefore, could be a potential anti-aging and oxidative stress-preventing agent. Palm-based cosmetic products formulated with palm tocotrienol-rich fraction (TRF) can moisturize the skin by increasing skin hydration. A single dose application of the cream can maintain skin hydration for up to 3 hours. Long-term applications of tocotrienol creams have also been shown to enhance skin hydration for up to 14 days when compared to placebo (sugar pill).

Fig. 3. Oil palm based cosmetic products

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Agrochemicals

Products are formulated to cater to different types of applications in agro-industry. Examples of such formulations include aqueous concentrates (AC), emulsifiable concentrates (EC), wettable powders (WP), suspension concentrates (SC), emulsion in water concentrates (EW), suspo-emulsions, and water dispersible granules (WDG). There has been a shift recently in agrochemical formulations practices, for instance from emulsifiable concentrates (EC) to emulsion in water (EW), wettable powders (WP) to water dispersible granules (WDG), and powders or dusts to suspension concentrates (SC). This shift is said to provide products that are safer and more convenient to the end users. With this, the use of flammable or toxic solvents is avoided, and bulky and dusty products are being removed from the market. Other factors such as ease of handling, safer, and more convenient disposal of packing materials are becoming increasingly important. There are two main components in agrochemical product formulations, namely the active and inert ingredients. The former is responsible for protecting targeted plants by destroying insects, fungi, and weeds or protecting them from attack by these pests. Meanwhile, the inert ingredients, which include wetting agents, dispersing agents, emulsifiers, spray adjuvants, solvents, carriers, and others, are added to the formulation to enhance the performance of the active ingredient. In agrochemical industries, surfactants are used as additives primarily in pesticides (herbicides, insecticides, fungicides) and to a lesser degree in fertilizers, animal feeds, and soil treatments. When used as a pesticide adjuvant, surfactants provide emulsifying, dispersing, sticking, and foaming aid action. Emulsifying the active ingredients in liquid formulations creates stable emulsions and extends shelf life. Dispersing agent is to aid application of the active ingredients. A sticking agent improves contact of the active ingredients onto the left surface of the crop or weed, while a foaming aid controls spray drift during pesticide application. The other inert ingredient where oleochemical can be used is in the area of solvent. Oleochemical, such as methyl esters, can be used to replace the petroleum-based solvent and this replacement has proven to be beneficial in reducing skin allergies among farmers.

Lubricants

Lubricants are materials used to reduce friction between machinery parts in motion and minimize wear between interacting surfaces. Due to their vast applications in many industries such as industrial machineries, mining, metalworking, fiber and textile manufacturing, agriculture, forestry, construction, railway systems, and recreation sports, they tend to pollute the environment in small but widespread quantities. The lubricant comprises 90% base oil and 10% additives. Conventional base oils are made of mineral oil and are for general-purpose applications and not

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for high-performance engines. Synthetic lubricants were developed to meet the stringent requirements for high-performance engines. They are expected to have better lubricity and biodegradation characteristics. There are various types of synthetic base oils e.g., polyalphaolefin, esters, silicone oil, phosphate esters etc. The esters can be derived from the fatty acid from palm and palm kernel oil. Metathesis of palm methyl oleate to octadecene can be used for synthesis of the star-shaped lubricants. Oxidative cleavage of palm oil and its products followed by esterification produced mono and diesters that can be a good lubricant base oil.

Palm oil-based printing ink and de-inking agent

The palm oil-based printing ink has been developed and its performance is almost comparable to the petroleum-based ink in terms of glossiness. It has also been demonstrated that several palm-based surfactants can be used to de-ink paper printed with both palm oil-based ink and mineral oil-based ink for recycling purposes. This development has very important environmental implications as it enhances the quality and acceptance of recycled paper.

Conclusion

The oil palm industry (plantation and milling) generates large amounts of solid waste in the form of empty fruit bunches (EFB), palm kernel shells (PKS), mesocarp fiber (MF), oil palm fronds (OPF), and oil palm trunks (OPT). This leftover waste is collectively termed oil palm biomass (OPB). Oil palm is a well-known plant for its renewable energy sources, for example, huge quantities of biomass by-products are developed to produce value-added products such as methane gas, bio-plastic, organic acids, bio-compost, plywood, activated carbon, and animal feedstock. Even waste effluent; palm oil mill effluent (POME) has been converted to produce energy. Oil palm has created many opportunities and social benefits for the locals. In addition to this, one of the major attentions is bio-diesel from palm oil. This palm oil bio-diesel is biodegradable, non-toxic, and has significantly fewer emissions than petroleum-based diesel (Petro-diesel) when burned. Oil palm and its byproducts can also be utilized in developing various non-edible products such as oleochemicals, surfactants, cosmetics and personal care products, agrochemicals, lubricants and palm oil-based printing ink and de-inking agents.

References

Basiron, Y. 2001. New palm-based products. *Journal of Oleo Science*. 50(5): 295-303.

Nesaretnam, K., Yew, W.W. and Wahid, M.B. 2007. Tocotrienols and cancer: beyond antioxidant activity. *European Journal of Lipid Science and Technology*. 109(4): 445-452.

Yeong, S. K., Idris, Z. and Hassan, H. A. 2012. Palm oleochemicals in non-food applications. In *Palm Oil*: 587-624. AOCS Press.