Surface Active Products from Sandal Seed Oil

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Formation of surface active products with good foaming capacity and foam stability from sandalseed oil by reaction with (i) diethanolamine, (ii) gelatin hydrolysate and (iii) sodium-ammonia is described.

The annual availability of the seed of sandal (*Santalum album* Linn.), a species which fruits profusely, in the states of Karnataka and Tamil Nadu, the main sandal growing states in India, is nearly 20,000 tons. The seeds contain about 50 to 60% of a drying oil (1-3) rich in santalbic glyceride (4-6). Resins like colophony and copal can be dissolved in the oil at 180-200 C, yielding an orange colored varnish (7) possessing good insulating properties. The oil can be made to react with zinc chloride, yielding a dark plastic solid which, on dissolving in benzene, forms an ideal base for insulation tapes (7). The santalbic acid of the glyceride in the oil was found to form, with dimethyl sulfate, a molecular inclusion complex possessing detergent action (8).

Products like liquid detergents, shampoos, foam boosters and emulsifying, thickening and wetting agents are reported to be formed by reaction of many fatty acids or their methyl esters with diethanolamine, giving rise to fatty alkanol amides (9,10), or by condensation reaction of fatty acid methyl esters with polypeptides like gelatin (11). In our studies on sandal seed oil, we found that surface active products with good foaming capacity and foam stability can be obtained by directly reacting the oil with (i) diethanolamine and (ii) alkali-hydrolysate of gelatin. Also, treatment of sandal seed oil with sodium and ammonia was found to result in a soap-like solid substance. Details of these studies are presented in this paper.

MATERIALS AND METHODS

Reaction with diethanolamine. To 1.5 ml dry methanol was added 0.2 g sodium. When the reaction was complete, excess methanol was distilled off and to the sodium methoxide were added 22 g sandal seed oil and 10 g diethanolamine. The mixture was heated at 150 C for 2 hr. After cooling to 25 C, 100 ml ether was added and shaken well. The globules that settled at the bottom were separated by decanting out the ethereal solution. The globules were further shaken with 2 × 50 ml ether. The combined ethereal solution was evaporated, and 100 ml ethanol was added to the residue. The waxy matter was filtered off and washed with 3 × 20 ml ethanol. Evaporation of the alcohol solution followed by drying under vacuum, gave the surfactant (27 g), a reddish brown thick liquid, which turned slowly into a semi-solid mass: IR 3350 (O-H), 2920-2850 (C-H), 1630 (C=O of amide), 1470 (C-H), 1060 (C-O), 960 (=C-H) cm^{-1}. Foaming capacity and foam stability were assessed following the procedure of Ogino and Takigami (12). A 1% aqueous solution of the surfactant gave foam volume 23 (ml) and had foam stability 440 (min).

Reaction with gelatin hydrolysate. 1.5 g Sodium hydroxide was dissolved in 50 ml 80% aqueous ethanol, and then 15 g gelatin was added. The mixture was refluxed for 6 hr, when gelatin went totally into solution. To the hydrolysate was added 10 g sandal seed oil. The contents were then evaporated and the residue obtained was heated at 135-140 C for 2 hr. The reaction mixture was cooled to 25 C and leached with 5 × 20 ml petroleum ether (60-80 C). The residue was taken in 50 ml hot ethanol, filtered and washed further with 3 × 20 ml ethanol. Evaporation of the alcohol solution gave 6.2 g yellow brittle surfactant: IR 3310 (N-H), 2920-2850 (C-H), 1745, 1710 (C=O), 1550 ($-COO^-$), 1460-1380 (C-H) 960 (=C-H) cm^{-1}. A 1% aqueous solution gave foam volume 41 (ml) and had foam stability 225 (min).

Reaction with sodium and ammonia. To 10 g seed oil taken in 30 ml hexane were added 5 ml ammonia (Sp. Gr. 0.89) and 0.5 g sodium. The mixture was refluxed for 6 hr and kept for cooling overnight. The product was filtered and washed with 3 × 20 ml hexane. To the creamy white mass on filter, was added 3 × 35 ml hot ethanol. Evaporation of alcohol gave 7.5 g whitish yellow solid soap: IR 3350 (O-H), 2920-2850 (C-H), 1750 (C=O), 1560 ($-COO^-$), 1460-1380 (C-H), 1050 (C-O), 960 =C-H) cm^{-1}. A 0.5% aqueous solution gave foam volume 48 (ml) and had foam stability 210 (min). The soap, upon acid hydrolysis followed by methylation and analysis of methyl esters by GLC (DEGS, 180 C), showed myristic 3.4, palmitic 3.1, oleic 15.8, stearolic 4.5, and santalbic 73.1, while the soap directly obtainable (yellow amorphous mass) from the seed oil by saponification under similar conditions, analyzed for myristic 0.6, palmitic 1.2, oleic 14.6, stearolic 2.9, and santalbic 80.4.

RESULTS AND DISCUSSION

The present study has shown that by directly reacting the sandal seed oil with (i) diethanolamine, (ii) gelatin hydrolysate and (iii) sodium-ammonia, surface active products with good foaming capacity and foam stability can be obtained. This finding adds to the variety of uses to which the sandal seed oil can be put and is of particular significance in view of the availability of sandal seed in huge amounts.

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ADDENDUM

The following acknowledgment was intended for inclusion with "Indian Ricebran Lecithin," written by S. Adhikari and J. Adhikari (Das Gupta) and published in the October issue of the *Journal of the American Oil Chemists' Society:*

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