EVALUATION OF *Vernonia galamensis var nairobensis'* SEED OIL AS POTENTIAL RAW MATERIAL FOR SOAP MANUFACTURE

MUNYALI BENSON MUNYALI WAMALWA

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ABSTRACT

The quality (or characteristics) of a soap is governed by a number of physicochemical factors that need considerable attention. For instance, the type of oil/fat used as raw material and the soap preparation procedure are among some of the most important parameters to be considered. In this work the potential of *Vernonia galamensis* seed oil (VGSO) as a raw material for soap manufacture was evaluated. Various technical factors/parameters that constitute criteria for the selection of oils and fats for soap manufacture were considered. The physical qualities of the soaps derived from VGSO were determined.

Unrefined crude *Vernonia galamensis* seed oil (CVGSO-dark colored) was further purified to yield more refined *Vernonia galamensis* seed oil (RVGSO-sand/beige colored). Polystyrene standardized infrared (IR) spectroscopic analysis of RVGSO confirmed the presence of epoxytriglycerides as was indicated by the triglyceride ester triplet absorption at 1240, 1160 and 1090 cm^{-1} and the epoxy doublet absorptions of 845 and 825 cm^{-1} on the oil's IR spectrum.

Evaluation of the analytical parameters showed that RVGSO was 98% saponifiable. One gram of the oil was fully saponified by 0.173g of potassium hydroxide (saponification value 173.28). The oil's fatty material had a mean gram-molecular equivalent (saponification-equivalent) of 323.75. RVGSO's iodine value, INS factor and titer range were estimated to be 87.26 ±0.97g/100g oil, 86.02 and 3-6°C, respectively.

Siwoloboff's method gave a boiling point range of 187-190°C (760mm Hg) with RVGSO showing evidence of decomposition / polymerization. The vapor pressure method gave a boiling point of 153.8°C with no sign of oil decomposition/polymerization. The oil had an enthalpy of vaporization (ΔH_{vap}) of 24.32 Kj $K^{-1}mol^{-1}$ and a calorific value of 34.44±1.11 Kj / g. It was noted that full-boiled

saponification of RVGSO was extremely quick and proceeded smoothly; cold saponification was relatively difficult.

Dry neat soap of RVGSO had a glossy appearance and was beige in color. The fine-grained soap was solid and hard on formation. The soap, was soluble in cold (26°C or colder) soft water, lathered and foamed quickly and substantially with water. Though the later was non-lasting, it had good cleansing properties very much similar to those exhibited by soap obtained from refined coconut oil. RVGSO soap was found to be non-irritating to the skin and highly emolient (smoothing to the skin).

On analysis, RVGSO neat soap was found to contain 62.3 % total fatty acid (TFA), 34.9 % moisture and volatile matter (MVM), 4.86 % combined alkali, 1.41 % water equivalent of fatty acid (WEFA), 60.84 % fatty anhydride (FAH) and 65.7 % anhydrous or real soap (AHS). Neat soap yield was found to be 227.1 % and the theoretical glycerol yield was calculated to give 9.8 %. The above per cent values are calculated on a weight to weight (W/W) basis.

The critical micelle concentration (CMC) of soap synthesized via cold saponification reaction (herein designated as VERN surfactant) was estimated to be 0.38 % at 22°C with a micellar aggregation number and core volume of 16 (25°C) and 7755 cubic Angstroms, respectively. Hard water reactions revealed that RVGSO neat soap, had less tendency to form scum precipitate and therefore minimized formation of scum deposits and consequently cloth hardening when used as a cleansing agent.

Gas chromatographic (GC-MS) and IR characterization of soaps obtained on saponification of RVGSO led to the conclusion that RVGSO was an ambident substrate i.e. could be attacked at two points, when used as a substrate in high temperature (≥ 70°C) saponification conditions. Saponification of RVGSO using ethanolic potassium hydroxide under reflux at 70°C, cleaved the oxirane ring with subsequent formation of

vic-diol soaps. Formation of such soaps indicate an alkali-catalyzed hydrolysis of the epoxy ring in addition to the hydrolysis and neutralization of the oil's triglyceride esters. Cold saponification (25°C) of RVGSO under similar alkali conditions resulted in potassium soap with the epoxy ring uncleaved. The soap product with the intact oxirane ring gave a negative polyhydric alcohol test, as would be expected.