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Determination of Foam And Emulsion Powers Of Crude Methanol Extracts From *Jatropha Curcas* And *Balanites Aegyptiaca* Plants

Ambair i. K.

Post Graduate Student: School Of Pure And Applied Sciences, Modibo Adama University, Yola, Nigeria
E-mail:ishayakee@gmail.com

Dr. Doughari J. H.

Lecturer; School Of Pure And Applied Sciences, Modibo Adama University, Yola, Nigeria

Dr. Joel U. E.

Lecturer: School Of Pure And Applied Sciences, Modibo Adama University, Yola, Nigeria

ABSTRACT

The foaming and emulsifying powers of *J. curcas* and *B. aegyptiaca* extracts were determined using foam accumulates height produced initially at time zero and thereafter five minutes and the formed emulsion before and after heating over water bath at 80^{o}c for 30 minutes where the two plants and the standard detergent Waw demonstrated remarkable activity. However, extract of *J. curcas* showed better foaming capacity and stability of 100% and 96.7% the first ever reported elsewhere while *B. aegyptiaca* on the other hand showed better emulsifying capacity and stability of 81.8% and 63.2% as against the standard detergent Waw with 100% and 66.7% foam and 72.7% and 46.2% emulsion capacity & stability respectively. These therefore indicate that both plants demonstrated very high foam and emulsion powers in which both are important properties of surfactant. Hence, with further purification and modifications in the lagging properties of the crude extracts, they may serve as good sources of natural surfactants (foaming and emulsifying agents) which are environmentally friendly and biocompatible raw materials pertinent in reducing the fear of depletion of the main source of synthetic detergent which is petroleum.

Keywords*: J. curcas, B. aegyptiaca,* surfactant, foam, emulsion, capacity, stability.

2.0 MATERIALS AND METHODS

2.1 Materials

The materials needed includes: Plants, the standard reference Waw detergent, 30 cm ruler, retort stand, analytical balance, stop clock, 50 ml burettes, 10 ml test tubes, pestle & mortar, electric grinder, solvents, whatman No. 1 filter papers, 0.45µm bacteriological filters, nylon cloth, rotary evaporator, laminar flow cabinet, containers, plastic bags and sterile distilled water.

2.1.1 Plants' Identification and Authentication.

Fresh leaves, flowers and fruits where applicable were collected from plants in the wild and taken to Botany department of Taraba State University (TASU) Jalingo where they were all identified and authenticated as *B. aegyptiaca* and *J. curcas.*

2.1.2 Samples' Collection and Processing.

Stem bark of *B. aegyptiaca* were cut and sliced with flame- sterilized axe and knife after the removal of the scaly outer layer to two-third full polyethylene bag then sun-dried to constant weight during the month of September and kept at 4^{o}c until required. In the case of *J.curcas,* apex of young twigs and fruits stalks were broken with the free-oozing latex from them collected aseptically into sterile Mac-katney bottles in the month of May and kept at 4^{o}c until required. However, *B. aegyptiaca* kept sample was later processed further by removing it at 4^{o}c and allowing it to stand on the bench for 30 – 45 minutes at room temperature after which it was transferred into an incubator at 45 ^{o}c for further 10 hours then subjected to pounding in a well cleaned alcohol disinfected mortar and pestle, grinding in an electric blending machine and sieving with sterile nylon sieve where the resulting fine powder was kept in a sterile container at 4^{o}c until required.

2.1.3 Extraction of Crude Extracts from Processed Plants' Samples

Processed plant' samples above were each weighed 100g except for *J. curcas* where 203 ml was measured, evaporated in rotary evaporator then dried in a laminar floor hood producing 112g dry weight and thereafter both were subjected to serial exhaustive maceration in five different solvents in a ratio of 1:10 starting with the non-polar to most polar solvent (i.e. hexane → chloroform → acetone → methanol → water) for 72 hours with 4 hourly agitations. In each case, the obtained macerate was strained and pressed through a nylon cloth then filtered first through what man No. one filter paper and then through a 0.45µm bacteriological filter before evaporation of the filtrate in a rotary evaporator and drying to constant weight in a laminar flow cabinet at 45^{o}c thereby producing the crude extracts that were kept at 4 ^{o}C until required.

For this study only methanol crude extracts of the two plants were used.

. 2.1.4 Preparation of Crude Extracts and Reference Standard Waw Detergent Solutions for Determination of Foam and Emulsion Activities

Weighed 0.4g of each test and control were transferred into correspondingly labeled containers and 100 ml distilled water added to each forming a solution of 0.004g/ml (4mg/ml) concentration.

2.2 METHODS

2.2.1 Foam Production by Modified Ross-Miles, (1941) Method.

50 ml of the above prepared test/control was transferred into a 50 ml burette in a retort stand clamped at a height of 11.0 cm where the solution therein was run out into a receiver (50 ml beaker) and thereafter:-

i, Foam height was immediately measured at time zero (t_0) then thereafter five minutes (t_5) and

ii, Aqueous solution (liquid) height were all measured at each of the specified time in one (i) above. This procedure was repeated 3x and their mean used for the calculations of foam capacity and stability. In all cases, measured heights were recorded for tests and standard Waw and then used for calculating the foam capacity and stability using the formula:

$$\text{a) Percentage of foam capacity} = \frac{\text{Height of foam above aqueous solution X 100}}{\text{Height of aqueous solution}}$$

$$\text{b) Percentage of foam stability} = \frac{\text{(Height of foam at time zero – height of foam after 5mins) X 100}}{\text{Height of foam at time zero}} \quad 1$$

2.2.2 Emulsion Formation by Modified Methods of Agu and Barminas, (2013) and Wang and Kinsella, (2015).

Five (5) milliliters volume of the prepared test solution (extracts & standard) above was transferred into a 25 ml beaker and equal volume of 5 ml of paraffin oil was added then mixed and homogenized thoroughly using 10 ml syringe by repeated sucking and expelling to ensure droplets break-up until a creamy homogeneous emulsion was formed. This procedure was repeated 3x for each sample with their mean obtained and used.

2.2.2.1 Emulsion Capacity

The formed emulsion above was transferred into a 10 ml test tube and allowed to stand for 15 minutes at room temperature in a rack and the heights of both emulsion and aqueous solution measured with a ruler and recorded then used for the calculation of the emulsion capacity. Also the process was repeated 3x for each sample and the mean recorded and used for the percent emulsion capacity calculation using the formula below.

$$\text{Percent emulsion capacity (EC)} = \frac{\text{Height of emulsion } (E_B) \quad x \quad 100}{\text{Height of aqueous solution } (A_B)}$$

2.2.2.2 Percent Emulsion Stability

The test solution from the completed percent emulsion capacity above was heated over a water bath at 80^{o}c for 30 minutes then cooled down to 15^{o}c and centrifuged at 4,000 rpm for 6 minutes after which the heights for both the emulsion (E_A) and aqueous solution (A_A) were measured with a ruler and recorded then used to calculate the percent emulsion stability as below. This procedure was also repeated 3x and their obtained mean used for the percent emulsion stability calculation using the formula below.

$$\text{Percent emulsion stability (ES).} = \frac{\text{Height of emulsion } (E_A) \times 100}{\text{Height of aqueous solution } (A_A)}$$

3.0 FINDINGS

3.1 Foam Capacity and Stability

Walstra P. (1989) stated that foaming agents are surfactants and so they are necessary for foam production and stabilization. Foam by definition, is the dispersion of gas bubbles separated by thin layer of liquid films. Thus, results from this study shows that latex methanol extract of *J. curcas* plant has the highest foaming capacity of 100% competing favorably with that of the commercial detergent Waw with 100% but better than 83.3% of the stem methanol extract of *B.aegyptiaca* plant (Table1). Similarly, the latex methanol extract of *J. curcas* demonstrated the highest foam stability value of 96.7% better and higher than those of both *B. aegyptiaca* with a value of 92% and the commercial detergent Waw with only 66.7% which is the lowest of them all. Thus the high foam capacity and stability demonstrated by methanol extract of *J. curcas* is the first ever reported elsewhere while that shown by *B. aegyptiaca* is in consonant with the findings of Agu and Barminas (2013).

Extracts from the two plants studied showed differences in foam capacity and stability percentages which may be ascribed to the type and quantity of the stabilizing agent present in them as they are a necessity in stabilizing and generating the foam which otherwise will be short-lived because the bubbles will have rapidly coalesced with resultant collapsed foam. Hence stabilizing agents protects the generated bubbles in foams from collapsing and examples of such agents are surfactants, particles, polymers and their mixtures. This therefore implies that *J. curcas* may have strong and sufficient amount of the stabilizing agents present in it than the other two which is the case with what Pradhan & Bhattacharyya (2014) reported that foaming increases as stabilizing agent increases too.

3.2 Emulsion Capacity and Stability

Emulsions are an important property of surfactant and also help it to solubilize water insoluble substances due to its amphiphilic nature. The plants and the standard commercial detergent Waw studied all showed varying levels of emulsion capacity and stability with *B. aegyptiaca* plant extract showing the highest percentage emulsion capacity and stability of 81.8% and 63.2% (Table 2) which is in agreement with Agu & Barminas (2013) that showed *B. aegyptiaca* to also have high emulsion capacity and stability. Second to *B. aegyptiaca* is *J. curcas* with better emulsion capacity of 78.4% the

first ever reported elsewhere than the commercial detergent Waw with the least capacity of 72.7% . However, Waw detergent has a better emulsion stability of 46.2% than *J.curcas* with 45.2% (Table 2) indicating lesser emulsion stability and so not suitable emulsifiers. The high emulsion activity shown by *B. aegyptiaca* could be as the result of the presence of sufficient quantity and types of emulsion agents and or surfactants ((Birdi, 2010), Muntaha & Khan,2015) as they possesses emulsion activity and are usually adsorbed at the oil-water interface resulting in reduced interfacial tension or energy such that less energy or tension is spent to form the oil-water interfaces required for emulsion formation and stability (Kothekar, *et. al.*, 2007*)* and hence the observed differences in activity of the three samples seen since one or the other may have less or more of the emulsifying agents and or amphiphilic surfactants..

Table 1: The percentage foam capacity and stability of plants methanol crude extracts.

SAMPLE	HEIGHTS (cm)					
	AQUEOUS SOLUTION (A)	FOAM AT TIME (min)			CAPACITY (%)	STABILTY (%)
		T_0	T_5	R5 ($T_0 - T_5$)	[T_0 X 100/A]	[R5 X 100/T_0]
Waw deter-gent	3.0	3.0	2.0	1.0	100	66.7
Balanites aegyptiaca	3.0	2.5	2.3	0.2	83.3	92.0
Jatropha curcas	3.0	3.0	2.9	0.1	100	96.7

key;-

T_0 = Initial foam height at time zero minutes

T_5 = Foam height after five minutes

R5 = Foam decay (difference of initial foam height at time zero and that after five minutes)

A = height of aqueous solution of extract

Table 2 : The percent emulsion capacity and stability of crude extracts of plants.

SAMPLE	HEIGHTS (cm)				CAPACITY (%)	STABILTY (%)
	BEFORE HEATING AT 80^0 C		AFTER HEATING AT 80^OC		$[E_B \times 100/A_B]$	$[E_A \times 100/A_A]$
	AQUEOUS SOLUTION (A_B)	EMULSION (E_B)	AQUEOUS SOLUTION (A_A)	EMULSION (E_A)		
Waw detergent	55	40	65	30	72.7	46.2
Balanites aegyptiaca	55	45	60	35	81.8	63.2
Jatropha Curcas	51	41	70	33	78.4	45.2

4.0 CONCLUSION AND CONTRIBUTION

The study has identified *J. curcas* and *B. aegyptiaca* plants as good sources of foaming and emulsifying agents or better still surfactants. Hence, the high percentage foam power shown by *J. curcas* in this study is the first ever reported elsewhere. More so, both extracts were found to have superior foam and emulsion powers than the commercial detergent Waw. Thus, the use of *J. curcas* methanol latex and *B. aegyptiaca* methanol stem bark extracts as raw materials will go a long way in cutting cost spent on production of synthetics and also reducing .the environmental hazard posed by them. Furthermore, their bioavailability, low toxicity (Roy *et. al.* 1997*)*, biodegradability, cost, biocompatibility, environmental risk (Jonsson *et. al.* 2001) and specificity because of their natural origin (Jonsson *et. al.*2001) over the

synthetic will be of great importance in the pharmaceutical, cosmetics, food, paint, and fire extinguishers industries in the production of safe products.

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