Sys Rev Pharm 2024; 15(10): 321-323
A multifaceted review journal in the field of pharmacy
E-ISSN 0976-2779 P-ISSN 0975-8453/DOI: 10.31858/0975-8453.15.10.321-323

Research Article

Foaming Characteristics of Crude Saponins Found in the Seeds of *Balanites aegyptiaca* (DEL)

Abubakar I[1*], Sodipo OA[2], Zakariyya HB[2]

[1]Department of Biochemistry, Gombe State University, Gombe State, Nigeria
[2]Department of Biochemistry, University of Maiduguri, Borno State, Nigeria

Article History: *Submitted: 03.10.2024* *Accepted: 23.10.2024* *Published: 30.10.2024*

ABSTRACT

In this study, the foaming potentials of saponins from the seeds of *Balanites aegyptiaca* (DEL) were assessed by evaluating the foam heights of the crude saponin extract in comparison with commercially available detergents, including Tween 80 and Triton-X-100, at varying concentrations of 0.2%, 0.4%, 0.5%, 0.6%, 0.8% and 1.0%. The foam heights of the various extracts were analyzed statistically using Analysis of Variance (ANOVA) to determine differences at 0 minutes, 1 minute, 5 minutes and T (hour).

The results showed that the crude saponin extract, as well as Tween 80 and Triton-X-100 solutions p>0.05, were not significantly different.

The crude saponin extract formed foam with the highest height of 3.35 ± 0.13 cm at a concentration of 1.0% at the initial time, with a foaming time of 4.68 ± 0.32 hours. It was observed that the crude saponin extract exhibited significant foam power and foam stability compared to the other extracts and was regarded as metastable at a concentration of 0.5%. The foam power of the crude saponin extract solution from the seeds was found to be 19.2% of the 0.5% Triton-X-100 solution, while the foam power of the 0.5% crude saponin extract solution was 28.8% of the 0.5% Tween 80 solution.

Keywords: Saponins, *Balanites aegyptiaca*, Foam power, Foam stability, Foam height

***Correspondence:** Abubakar I, Department of Biochemistry, Gombe State University, Gombe State, Nigeria, E-mail: ibrahimabubakar@gsu.edu.ng

INTRODUCTION

The name saponins is derived from the latin word sapo, which means frothing agent. Saponins consists of polycyclic aglycones (Hamidou TH, *et al*., 2002). The sapogenin or aglycone part is either a triterpene or steroid linked to one or more oligosaccharide moieties by glycosidic linkage. These compounds are water-soluble constituents distinguished by their ability to form soapy foam even at high dilutions (Birk Y, *et al*., 1963). Some saponins can be toxic and are referred to as sapotoxins (Barker JT, 2009).

The most significant dietary sources of saponins include legumes such as soybeans, chickpeas, mung peas, broad beans, kidney beans and lentils. The common onion is another important source of dietary saponins (Sodipo OA and Arinze HU, 1985).

Balanites aegyptiaca is an evergreen, multi-branched, spiny shrub or tree that grows up to 10 m in height. It has a crown-rounded shape with long stout branches and its trunk and bark are grey and deeply fissured longitudinally (Morgan N, 2008).

Desert date is valued for its fruits, which are often referred to as slave dates due to their poorer nutritional quality compared to true dates. However, they are held in high regard in arid regions, particularly during times of hardship. The fruits can be cooked to extract their sugar content, which can then be added to porridge or used for making sweetmeats (Hall JB and Walker DH, 1991). The presence of certain secondary plant metabolites closely related to saponins complicates their identification among similar compounds since they lack chromophores (Barker JT, 2009). Consequently, crude saponins are the focus of this study. The aim of this research is to determine some foaming characteristics of crude saponins extracted from the seeds of *Balanites aegyptiaca*, with the goal of updating the reference list of saponin containing plant parts (Yang CH, *et al*., 2010)

MATERIALS AND METHODS

Collection of plant part

The seeds of *Balanites aegyptiaca* were collected from Maiduguri metropolis in Borno state and authenticated by a botanist from the Department of Biological Sciences, Faculty of Science, University of Maiduguri. A voucher specimen no. 89 of *Balanites aegyptiaca* was deposited at the department herbarium.

The materials used in this study included seeds of *Balanites aegyptiaca*, filter paper, a round bottom flask 250 mL, beakers 50 mL and 100 mL, a volumetric flask 250 mL, a digital weighing balance Bosch and Co. Ltd., Germany and a ruler. All other materials were of scientific grade (Sim SK, 1967).

Chemicals and reagents

The chemicals and reagents used in this study included concentrated tetraoxosulphate VI acid, hexane mayer and baker, Poole, England, distilled water, n-butanol Sigma-Aldrich, St. Louis, Germany, Mayer's reagent, Wagner's reagent, Fehling's solution, Methanol BDH Chemicals Ltd., PVT, India, Triton-X and Tween-80. All other chemicals and reagents were of scientific grade.

Preparation of crude saponins extract

The preparation of crude saponins extract was conducted as described by (Obadoni BO and Ochuko PO, 2002). A total of 100 g of the powdered sample was weighed and transferred into a clean conical flask. The sample was extracted by mixing it with 250 mL of distilled water, followed by filtration and boiling. The mixture was whirled occasionally and concentrated to 100 mL using an oven set at a controlled temperature of 50°C.

The concentrated mixture was then transferred into a 250 mL separating funnel using a funnel and partitioned with an equal volume of ethyl acetate. After standing for 24 hours, two clear layers were observed.

The lower layer was carefully collected in a beaker using a stopper and measured with a measuring cylinder. An equal volume of n-butanol was used to partition the measured lower layer, suspected to be the water layer. This mixture was left for another 12 hours for proper separation of the partitioned fractions.

Finally, the fractions were dried in a pan to obtain the crude saponins from the n-butanol layer.

Determination of foaming characteristics

The foaming characteristics of the extracts, including crude saponin extract, Tween-80 and Triton-X as standards, were determined at various concentrations of 0.2%, 0.4%, 0.5%, 0.6% and 1.0%. These concentrations corresponded to 0.01 g, 0.02 g, 0.025 g, 0.03 g, 0.04 g and 0.05 g for six determinations, respectively.

For each weighed extract, 5 mL of distilled water was added to a mortar and the mixture was carefully macerated and left to stand for 5 minutes. The resulting mixture was then transferred into a test tube using a Pasteur pipette. The test tube was corked and shaken using a whirl mixer. The foam heights were measured and recorded using a graduated ruler at the initial time, at 1 minute and at 5 minutes.

Additionally, the time for the total disappearance of the last trace of foam was also recorded.

Determination of foaming activities of Triton-x-100 and Tween 80 standards

The detergents Triton-X-100 and Tween-80 were prepared at the same concentrations as the samples: 0.2%, 0.4%, 0.5%, 0.6%, 0.8% and 1.0%. These concentrations represented volumes of 0.01 mL, 0.02 mL, 0.025 mL, 0.03 mL, 0.04 mL and 0.05 mL, respectively.

The measured samples were placed in test tubes and diluted with 5 mL of distilled water; agitation was achieved using a whirl mixer. The foam heights were recorded at the initial time, at 1 minute and at 5 minutes, along with the time for total disappearance of the last trace of foam.

RESULTS AND DISCUSSION

The results of the foam heights of the extracts indicated that the crude saponin extract from the seeds of *Balanites aegyptiaca* not only foamed copiously but also formed foam that lasted for a considerable length of time, as saponins are known to produce long-lasting foams (Harborne, 1973). The crude saponin extract exhibited the highest foam height of 3.35 ± 0.13 cm at a 1% concentration at the initial time, indicating a foaming time of 4.68 ± 0.32 hours, as shown in *Table 1*. A significant difference $p<0.05$ was observed across columns at 1 minute, 5 minutes and for the total disappearance of the last trace of foam. Although saponins are typically found in small concentrations, they are known for their long-lasting foams (Sodipo OA and Tizhe FS, 1991).

In comparison, the commercial detergent Tween 80 demonstrated a higher foam power of 8.60 ± 0.59 cm, with the highest foaming time recorded at 20.70 ± 0.49 hours. The Triton-X-100 solution exhibited a foam power of 12.35 ± 0.22 cm and a foaming time of 41.27 ± 0.32 hours. The rate of weakening of the foam from 0 minutes to 5 minutes defines foam stability (*Table 2 and 3*). The findings that foaming time was not always proportional to foam height align with observations made by (Sodipo OA and Arinze HU, 1985; Patrick IS, 2007).

The crude saponins extract, Tween 80 and Triton-X-100 solutions showed no significant differences $p<0.05$ when comparing foam stability from 1 minute to 5 minutes; however, the crude saponins extract did not significantly differ from Tween 80 and Triton-X-100 solutions $p<0.05$. It is important to note that solvents play an important role in extractions, as different solvents have been known to extract varying types of saponins, which can contribute to differences in the foaming characteristics of the extracts.

The foam power of the crude saponin extract was measured at 54.5%, indicating moderate foam stability when compared to Triton-X-100 and Tween 80 solutions, which had foam powers of 90.8% and 85.3%, respectively (*Table 4*). The foam power of a 0.5% crude saponin extract solution from *Balanites aegyptiaca* was found to be 19.2% compared to that of a 0.5% Triton-X-100 solution and was measured at 28.9% compared to a 0.5% Tween 80 solution. Furthermore, foam power greater than 50% is regarded as metastable.

Table 1: Foam heights and foaming times of crude saponins extract of seeds of *Balanites aegyptiaca* (DEL) at varying concentrations

Conc. (%)	Height (cm)			Time (hr)
	0 min	1 min	5 min	
0.2	4.17 ± 1.09	3.92 ± 0.82*	3.82 ± 0.72	24.35 ± 0.23
0.4	4.45 ± 1.00*	4.20 ± 0.83	3.95 ± 0.87	25.06 ± 0.20
0.5	4.75 ± 1.09	4.41 ± 0.81	4.11 ± 0.78	27.71 ± 0.19*
0.6	5.05 ± 1.18	4.62 ± 0.7	94.27 ± 0.69*	30.73 ± 0.19
0.8	5.08 ± 0.86	4.82 ± 0.74	36.39 ± 0.17	36.39 ± 0.17
1.0	5.20 ± 1.13	5.20 ± 0.86	5.10 ± 0.88	39.13 ± 0.20
Note: Data represented as Mean ± SD of six determinations, *p<0.05				

Table 2: Foam heights and foaming times of Tween 80 at varying concentrations

Conc. (%)	Height (cm)			Time (hr)
	0 min	1 min	5 min	
0.2	6.70 ± 0.12	5.80 ± 0.17*	5.40 ± 0.21	15.28 ± 0.32
0.4	7.60 ± 0.10*	6.50 ± 0.18	6.50 ± 0.14	16.65 ± 0.56
0.5	7.80 ± 0.09	7.05 ± 0.15	6.65 ± 0.19	16.98 ± 0.31*
0.6	8.00 ± 0.08	7.60 ± 0.12	6.80 ± 0.24*	17.30 ± 0.06
0.8	8.40 ± 0.22	7.70 ± 0.12	7.50 ± 0.16	18.18 ± 0.68*
1.0	8.60 ± 0.24	7.50 ± 0.35	6.80 ± 0.37	20.70 ± 0.49*
Note: Data represented as Mean ± SD of six determinations, *p<0.05				

Table 3: Foam heights and foaming times of Triton-X at varying concentrations

Conc. (%)	Height (cm)			Time (hr)
	0 min	1 min	5 min	
0.2	10.63 ± 0.14	11.38 ± 0.21	9.01 ± 0.24	24.33 ± 0.56*
0.4	11.38 ± 0.24	10.42 ± 0.22	10.10 ± 0.28	25.06 ± 0.49
0.5	11.57 ± 0.21	10.79 ± 0.18	10.51 ± 0.22	30.73 ± 0.45*
0.6	11.76 ± 0.18	11.15 ± 0.14	10.92 ± 0.16	36.39 ± 0.41
0.8	12.00 ± 0.11	11.92 ± 0.12	11.50 ± 0.19	39.13 ± 0.04*
1.0	12.35 ± 0.09	11.96 ± 0.11	11.62 ± 0.19	41.27 ± 0.33
Note: Data represented as Mean ± SD of six determinations, *p<0.05				

Table 4: Foam power and foam stability of various solutions at initial time to five (5) min

Conc. (%)	Height (cm)		R5 (%)
	0 min	5 min	T (hr)
Triton-X	11.57 ± 0.21	10.51 ± 0.22	90.8
Tween-80	7.80 ± 0.09	6.65 ± 0.33	85.3
Crude saponins	2.22 ± 0.20	1.21 ± 0.15	54.5
Note: Data represented as Mean ± SD of six determinations, *p<0.05			

CONCLUSION

The R5 value of the crude saponin extract from the seeds of *Balanites aegyptiaca* was found to be 54.5%. It can be concluded that the foaming characteristics of the saponins from the seeds of *Balanites aegyptiaca* align with documented characteristics of saponins, indicating that the potential for using crude saponin extract from these seeds as foam stabilizing agents is fairly good.

ACKNOWLEDGMENTS

The authors would like to thank all the laboratory staff of the Department of Biochemistry, Faculty of Science, University of Maiduguri for their support throughout this research work.

COMPETING INTERESTS

The authors declare that no competing interests exist concerning the publication of this manuscript.

REFERENCES

1. Hamidou TH, Kabore H, Ouattara O, Ouédraogo S, Guissou IP, Sawadogo L. Efficacy of *Balanites aegyptiaca* balanitaceae as anthelminthic and molluscicide used by traditional healers in burkina faso. Emerg Infect Dis. 2002; 37.
2. Birk Y, Bondi A, Gestetner B, Ishaaya I. A thermostable haemolytic factor in soybeans. Nature. 1963; 197(4872): 1089-1090.
3. Barker JT. Funtional genomics of triterpene saponins biosynthesis in *Medicago triancatula*. 2009.
4. Sodipo OA, Arinze HU. Saponin content of some Nigerian foods. J Sci Food Agric. 1985; 36(5): 407-408.
5. Morgan N. Cholesterol-lowering properties of saponins. Am J Clin Nutr. 2008; 30(1): 210-212.
6. Hall JB, Walker DH. *Balanites aegyptiaca*: A monograph. 1991. [Google Scholar]
7. Yang CH, Huang YC, Chen YF, Chang MH. Foam properties, detergent abilities and long-term preservative efficacy of the saponins from *Sapindus mukorossi*. J Food Drug Anal. 2010; 18(3): 7.
8. Sim SK. Medicinal Plant Glycosides. University of Toronto press. 1967.
9. Obadoni BO, Ochuko PO. Phytochemical studies and comparative efficacy of the crude extracts of some haemostatic plants in Edo and Delta states of Nigeria. Global J Pure Appl Sci. 2002; 8(2): 203-208.
10. Harborne JB. Phytochemical methods: A guide to modern techniques of plant analysis. 1973: 33-88.
11. Sodipo OA, Tizhe FS. A preliminary study of the saponin content of neem tree *Azadirachta indica*. Ann of Borno. 1991; 819: 142-149.
12. Patrick IS. Studies on saponins of leaf of *Clerodendron thomsonae* balfour. Acta Biol Szeged. 2007; 51(2): 117-123.