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Full Length Research Paper

Minimising the deterioration of the properties of *Moringa oleifera* seed extract using Trona solution

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This study intends to investigate the feasibility of using a local preservative under ambient environmental conditions to minimise the deterioration of *Moringa oleifera* seed extract in terms of pH fluctuations and coagulation properties. The effect of Trona solution on the pH stability of *M. oleifera* seed extract was evaluated by observing varying concentrations (0.5 to 2%) of mixtures of seed extract and Trona solution over a period of 19 days. Using an incremental dosage of 0.1g Trona added into 6 sets of 1 g/100 mL seed extract powder suspension and observing the respective pH for a period of seven days, the minimum amount of Trona solution required for a stable solution was determined to be at a dosage of 0.5 g. This was chosen as the minimum dosage required and consequently, preserved *M. oleifera* seed extracts of varying concentrations (2 to 15% w/v) were prepared containing Trona dosages of 0.5 g and above. The pH values were recorded over a 19 day period from which it was observed that for constant *M. oleifera* extract concentration, more pH stability was achieved at higher Trona dosages, that is. highest stability was achieved at a Trona dosage of 2.0 g/100 mL. While for constant Trona dosage, more pH stability was achieved at lower concentrations of *M. oleifera* extracts that is highest stability was achieved at 2% extract concentration. The Trona solutions maintained a consistently alkaline pH with an overall average variance of 0.0006. As little as 0.5 g/100 mL concentration of the preservative is capable of slowing the deterioration of a 1% (w/v) *M. oleifera* seed powder suspension. Therefore the possibility of using Trona, a locally available preservative, to extend the shelf life of a locally available coagulant, *M. oleifera* seed extract, appears to be very feasible.`

Key words: *M. oleifera* seed extract, Trona, preservative, stability, deterioration.

INTRODUCTION

Turbidity removal in water treatment can be achieved by the application of the coagulation – flocculation – sedimentation processes which often involves the addition of chemicals known as coagulants. Alum is at present the conventional coagulant of choice used in developing countries such as Nigeria and it is normally imported at the cost of huge foreign reserves (Muyibi and Bugaje, 2008). In addition to its cost, alum has also been associated with environmental and health concerns (Crapper et al., 1973; Miller et al., 1984). Fortunately an alternative coagulant has been found in the seeds of the *Moringa oleifera* tree, or "zogale" as it is locally known in northern Nigeria where it is being used for numerous traditional medicinal preparations (Saulawa, 2010).

For coagulation, the active ingredient in the seeds which has been reported to be of both proteinic (Gassenschmidt et al., 1995; Ndabigengesere et al., 1995; Okuda et al., 1999) and non-proteinic (Okuda et al., 2001a) in nature can be extracted using ordinary water, although several other solvents can also be used as reported in previous works (Muyibi and Evison, 1996; Ndabigengesere and Narasiah, 1998; Okuda et al., 1999; Gassenschmidt et al., 1995). Recent studies (Dishna, 2000; Levicki, 2005; Herbert, 2007) have shown that in its extracted form, the aqueous extract of the active ingredient from the seeds is unstable and normally deteriorates when stored under room conditions and can only be used within three days at most. This deterioration has been reported by Saulawa (2010) to be related to a decline in the extract's pH, and causes a decrease in its coagulation property and increase of repugnant odour in

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the treated water.

MATERIALS AND METHODS

M. oleifera seed

Dry *M. oleifera* seeds were obtained from backyard gardens within Samaru and Tudun-muntsira villages around Zaria in Nigeria. The pods were allowed to dry naturally on the tree prior to harvesting.

Preservative

For simplicity of technology and availability of materials, the locally available substance trona (commonly known as "potash" and locally known as "kanwa" in Northern Nigeria where it is being used to serve different purposes one of which is as a preservative), was chosen to be used as the preservative in this study. Trona is a naturally occurring greyish-white solid mineral with the chemical formula; Na_2CO_3 $NaHCO_3$•2(H_2O) and is known chemically as sodium sesquicarbonate (Solvay Chemicals 2005; Okere and Obimah, 1998). It is water soluble and the pH of 0.5, 1.0, 1.5 and 2.0% solutions had average value of 9.34 ±0.02 with negligible declination observed within 19 days (Saulawa, 2010).

Preparation of Trona solution

Blocks of Trona were ground to powder using pestle and mortar. 0.5 to 2.0 g of the powder was added to 100 mL of distilled water and the setup was stirred on a magnetic stirrer at high speed. After 10 min stirring the resulting solution was filtered through a Whatman No 1 filter paper.

Assessment of the buffering property of Trona solution

In order to evaluate the buffering property of Trona, varying concentrations (0.5 to 2.0% (w/v)) of its solution were prepared and their respective pH values were repeatedly measured every 3 days over a period of 9 days.

M. oleifera seed extract preparation

For the purpose of this study the extract was prepared by the following steps;

1) To obtain shelled kernel, the winged seed cover were removed by gentle pounding with a pestle.
2) The kernel was then grounded to a fine powder using a kitchen blender.
3) The powder was then sieved using a common kitchen sieve.
4) 2.0 to 15.0 g of the powder was added to 100 mL of distilled water and the setup was stirred on a magnetic stirrer at high speed for 15 min to obtain a suspension.
5) The suspension was first filtered through a four-layer muslin cloth, then through a Whatman No1 filter paper. The filtrate, referred to as the "fresh extract", which contains the bio coagulant is initially colourless then it becomes cloudy especially at high concentrations. When this extract is kept under room conditions for more than one day (that is beyond the day it was prepared) it is referred to as "deteriorated extract".

Extract preservation

In order to arrest the extract's deterioration, Trona solution was used instead of distilled water in the preparation of the extract and the extract was referred to as the "fresh preserved extract". It does not have a definite appearance just after filtration as it is sometimes colourless or at times cloudy. When this extract is kept under room conditions for more than one day (that is beyond the day it was prepared) it was referred to as "preserved extract".

Assessment of the effect of preservative dosage on M. oleifera seed extract's deterioration in terms of pH

1 g/100 mL seed powder suspension was prepared into six (6) conical flasks. The first flask served as the control, while varying dosages of Trona were added into the remaining five flasks (that is. 0.1, 0.2, 0.3, 0.4 and 0.5 g respectively). The respective pH values were recorded for a period of seven days to determine the minimum dosage required to arrest deterioration of the *M. oleifera* seed extract, which was observed as 0.5 g. Then four sets of preserved extract having different concentrations of *M. oleifera* seed powder were prepared (2, 5, 10 and 15%), and within each set four subsets were prepared using different dosage (concentration) of Trona solution (0.5, 1.0, 1.5, and 2.0 g/100 mL). The pH value of each individual extract was repeatedly measured every 3 days over a period of 9 days. It was expected that at the optimum Trona dosage, the pH of the respective extract would remain significantly stable over the period of study.

RESULTS AND DISCUSSION

Buffering property of Trona solution

The stability of the Trona solutions pH can be observed in Table 1, indicating increase pH stability with increasing Trona concentration, and consequently highest stability was observed for the 2% concentration. At this concentration, the pH variance was 0.0002. Negligible variations were recorded across the concentrations for the same day. It was observed that all the solutions had pH values within the alkaline region and for the entire period of analysis the pH of all the solutions were within a pH range of 0.1 from one another. This is an indication that Trona is an alkaline substance which by itself is capable of resisting shifts in its pH over time and it has the potentials to slow down the deterioration of *M. oleifera* seed aqueous extract.

Minimum concentration of Trona required to inhibit the deterioration of *M. oleifera* seed extract

The result for the seven day pH variation of *M. oleifera* seed powder suspension containing varying amount of Trona is as presented in Table 2. A steady stability in *M. oleifera* seed suspensions' pH was observed for increasing preservative dosage and the least variance (a value of 0.01) for all the samples was recorded at a dosage of 0.5 g. It can be inferred that the pH variation is dependent upon the preservative dosage added and lesser variations in pH can be an indication of stability. It can be seen that there was a decline in the pH within the first two days for the control. This can be as a result of

Table 1. pH for Trona solutions of varying concentrations.

pH values/ Trona solution (% w/v)	Days after preparation					Variance
	0	3	6	9	19	
0.5	9.34	9.33	9.32	9.30	9.25	0.001
1.0	9.35	9.34	9.32	9.33	9.28	0.001
1.5	9.33	9.32	9.31	9.30	9.28	0.004
2.0	9.34	9.33	9.31	9.32	9.30	0.002

Source: Saulawa (2010).

Table 2. pH for 1% (w/v) *M. oleifera* seed suspension containing varying dosage of Trona.

	Trona dosage (g/100 mL)	Days after preparation								
		0	1	2	3	4	5	6	Average	Variance
pH values	0.0	5.24	4.80	4.03	3.94	3.92	3.96	3.94	4.26	0.29
	0.1	9.75	9.23	8.64	8.29	7.88	6.44	6.57	8.11	1.58
	0.2	10.24	10.07	9.95	9.84	9.68	9.49	9.23	9.79	0.12
	0.3	10.35	10.25	10.11	10.03	9.90	9.76	9.56	9.99	0.08
	0.4	10.45	10.33	10.21	10.14	10.01	9.91	9.78	10.21	0.06
	0.5	10.51	10.47	10.45	10.38	10.31	10.28	10.18	10.37	0.01

Source: Saulawa, (2010).

acid formation which perhaps is the cause of the deterioration. Likewise a Trona dose of 0.1g was not enough to resist the shift in pH

Effect of preservative dosage on *M. oleifera* seed extracts' deterioration in terms of pH

The varying of *M. oleifera* seed extract concentration against Trona dosage was useful in explaining two variables; firstly, effect of varying preservative dosage on stability for constant extract concentration and secondly, effect of varying extract concentration on stability for constant preservative dosage. The first variation was analysed by considering the average of variance within sets, while the second variation was analysed by considering the average of variance across the sets. Table 3 shows the variance of each extract's pH and the average variance within and across the sets.

It can be observed that the higher the preservative concentration the lesser the fluctuation in *M. oleifera* seed extracts' pH values. The average of variance across the sets decreased steadily from a value of 0.051 at a preservative dosage of 0.5 g/100 mL to a value of 0.002 at a preservative dosage of 2.0 g/100 mL which is also the least observed value. This shows that higher preservation of *M. oleifera* seed extract can be achieved by increasing the dosage of the preservative.

Effect of varying *M. oleifera* seed extract concentration on stability for constant preservative dosage

For preserved *M. oleifera* seed extracts, lower concentrations were found to be more stable than higher concentrations because from Table 3, the least variance (a value of 0.0001) within a set was observed for the extracts (2%, 1.0 g) and (5%, 2.0 g) while the highest value of about 0.5 was observed for the (15%, 1.0 g) extract. The 2% *M. oleifera* seed preserved extract had the least pH fluctuation for all the concentrations of preservative, thus it was relatively stable right from a preservative concentration of 0.5 and 1.0 g/100 mL.

The least average of variance within sets (a value of 0.0004) for these extracts was observed at an extract concentration of 2%, while the highest (a value of 0.1481) was observed at 15% concentration. This shows that better preservation can be achieved at lower concentrations when compared to higher ones as can be seen in Figure 1. It also shows the possibility of obtaining longer shelf life by using lower extract concentrations for the given Trona dosages. No colloidal particles were seen in all the preserved extracts.

However some separations were observed as if some portion of the *M. oleifera* is dissociating from the Trona solution and a mat of sludge is formed at the bottom of the flask in which it was kept. It however gets reconstituted when shaken prior to administering in the jar test. Also at lower concentrations, the preserved extract maintained a fresh odour throughout the period of the experiment. Unfortunately the higher concentrations were found to be releasing an undefined odour (between freshness and repugnance).

Conclusion

The possibility of using a local preservative to extend the

Table 3. pH variance of individual preserved *M. oleifera* seed extracts, average pH variance within and across the sets.

	Trona concentration (g/100 mL)	Seed extract concentration (% w/v)				Average
		2	5	10	15	
pH variance	0.5	0.0010	0.0650	0.0120	0.1260	0.0510
	1.0	0.0001	0.1233	0.0330	0.4625	0.1555
	1.5	0.0005	0.0006	0.0487	0.0009	0.0130
	2.0	0.0006	0.0001	0.0023	0.0032	0.0020
	Average	0.0004	0.0473	0.0241	0.1481	

Source: Saulawa, (2010).

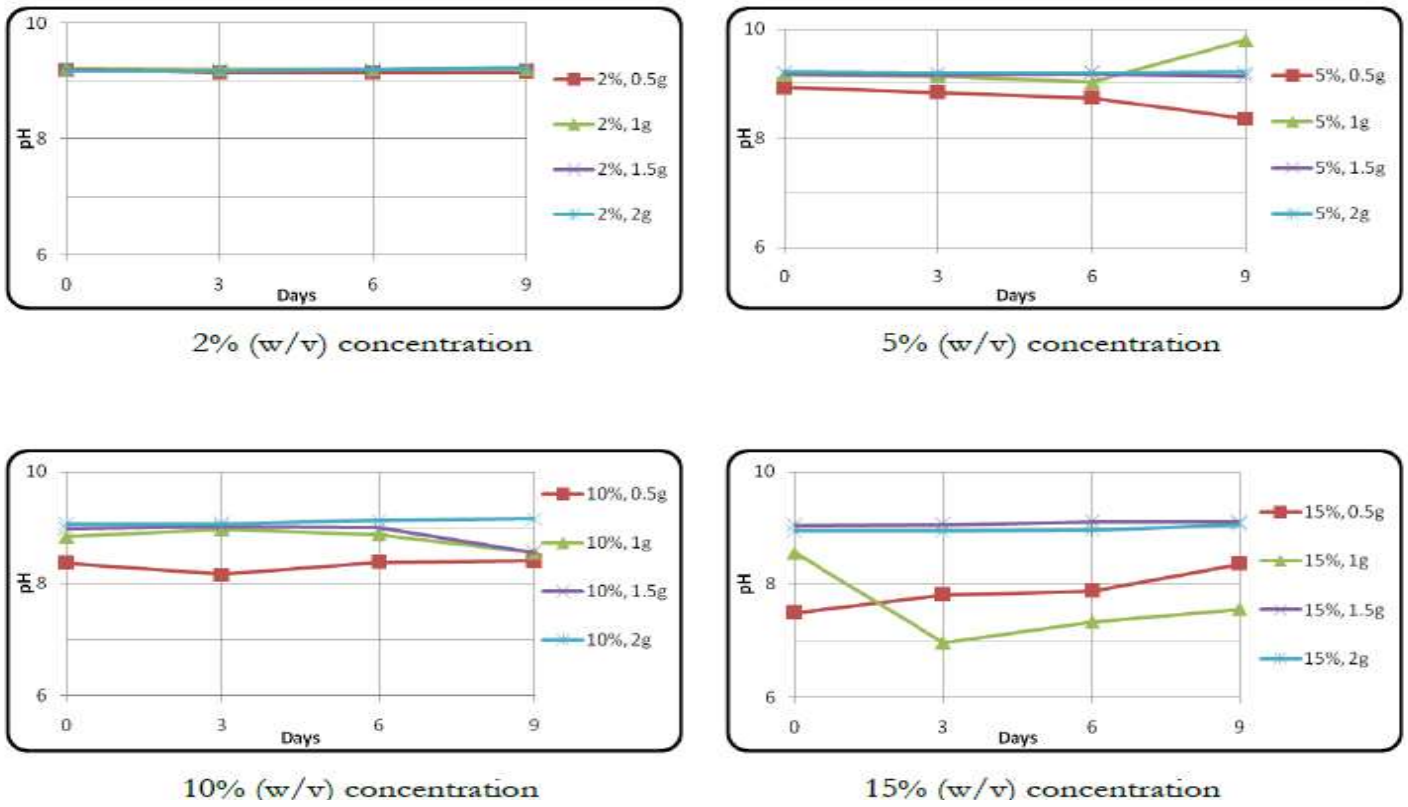

Figure 1. Variations of pH for given concentrations of *M. oleifera* seed extract containing varying preservative dosages. Source: Saulawa, (2010).

shelf life of *M. oleifera* seed aqueous extract has been studied and the results obtained were encouraging. This preservative, "Trona" a local substance commonly known as "potash", has been found to exhibit buffering properties. Its solutions maintained an alkaline pH consistently for a period of 19 days, with an overall average variance for pH of 0.0006. It has been found that as little as 0.5 g/100 mL concentration of this preservative is capable of slowing the deterioration of a 1% (w/v) *M. oleifera* seed powder suspension. Increasing the dosage of the Trona would result in a better preservation of *M. oleifera* seed extract. Alternatively lowering the concentration of the extract would result in a better preservation for given Trona dosage.

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