Effects Of Boiling, Fermentation And Ensiling On The Chemical Composition Of Velvet Leaf (*Waltheria indica* L.)

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Abstract: The study was conducted to determine the effects of boiling + fermentation and ensiling on the chemical composition of *Waltheria indica* leaves (WIL). The leaves were divided into three batches of 300g each in triplicates. The first batch was properly dried under shade designated as T_1, shade dried *Waltheria indica* leaves (SDWIL). The second batch was boiled for 30 minutes, dried and thereafter fermented in air-tight containers for seven (7) days designated T_2, boiled and fermented *Waltheria indica* leaves (BFWIL). The third batch was partially wilted and ensiled in polythene bags which were tightly placed in air-tight containers designated as T_3, ensiled *Waltheria indica* leaves (EWIL). The proximate composition, mineral content and levels of the anti-nutritional factors were significantly ($P<0.05$) influenced by the different processing methods. Dry matter loss of 3.23 and 2.24 % were recorded in the BFWIL and EWIL. An increase in the protein content of 9.37 and 21.69% were observed in the BFWIL and EWIL. An increase in the mineral content was recorded in the BFWIL and EWIL. Calcium, iron and magnesium increased by 1.89 and 15.97%, 10.05 and 19.85% and 3.10 and 3.63%, respectively. Levels of anti-nutritional factors were observed to significantly ($P<0.05$) reduced in the BFWIL and EWIL. Tannins and phenols reduced by 57.56 and 60.61% and 54.17 and 46.62%, respectively. It was concluded that boiling and fermentation and ensiling were effective in improving the nutritional profile and reducing the toxic components of WIL. However, nutrient losses in BFWIL was slightly higher than EWIL but the depreciation was not much. It is recommended that boiling + fermentation and ensiling can be used to process WIL>
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Introduction

The competition between humans and livestock for feed resources is on the increase and this has led to high cost of feed ingredients. The exploitation and the development of under-utilized shrubs as alternative sources of feed for livestock are necessary. It therefore, implies that, there is a dire need to search for cheaper alternative feed resources. Many indigenous tropical plants are under-utilized because little has been done to explore their utilization as feed ingredient (Augustine *et al*., 2017). Furthermore, the presence of anti-nutritional factors in forages has limited their utilization as feed resources for livestock (Oberleast, 1993). Therefore, there is a need to investigate detoxification methods that will improve their utilization as feed materials for livestock. Bioprocess technique such as fermentation and ensiling methods have been used to improve the nutritional profile of cereals and forages. However, information on the effects of ensiling and fermenting *Waltheria indica* leaves seems to be scanty. Hence, the need to conduct more studies and bridge the information gap. Therefore, the study was conducted to evaluate the chemical composition of *Waltheria indica* subjected to ensiling and fermentation processes. In view of the above, there is the need to determine the effect of fermentation and ensiling on the chemical composition of *W. indica* leaves in order to ascertain its suitability for livestock feeds.

The study therefore, determined the effects of fermentation and ensiling methods on the chemical composition of *Waltheria indica* leaves.

Materials and Methods

Location of the study area

Mubi Local Government of Adamawa State is located between latitudes 9°30' and 11° north of the equator and longitudes 13° and 13° 45' East of the Greenwich meridian. The temperature regime in Mubi region is warm to hot throughout the year however, there is usually a slight cold period between November and February. There is a gradual increase in temperature from January to April. The minimum and maximum temperatures of the area are 18.1°C and 32.8°C. The mean annual rainfall ranges from 900-1050 mm (Adebayo, 2004).

Collection and authentication *Waltheria iindica* Leaves

The test material, *Waltheria indica* leaves were harvested from the wild around Mubi area of Adamawa State, Nigeria. The leaves were authenticated at the Department of Animal Production, Adamawa State University, Mubi.

Processing of *Waltheria indica* Leaves

Waltheria indica leaves were divided into three batches. The first batch was properly air-dried under shade. The second batch was boiled for one hour and thereafter drained and properly squeezed to reduce the water content of the leaves. The leaves were placed in air-tight containers in triplicates and were allowed to ferment for seven (7) days. After which the leaves were removed and properly sundried. The dried fermented leaves were milled and used for the laboratory analysis.

The third batch of fresh *Waltheria indica* leaves were wilted and placed in polythene bags in triplicates and allowed to ferment for (7) days.

Chemical analysis

The samples were analyzed in triplicated for their proximate composition, mineral content and levels of anti-nutritional factors using the procedure described by AOAC (2004).

Data Analysis

Data obtained were subjected to Analysis of variance (ANOVA) of the Complete Randomized Design (CRD). Least Significant Difference was used to separate the means where significant difference occurred.

Results and Discussion

The proximate composition of shade air dried (SADWIL) and processed *Waltheria indica* leaves (PWIL) is presented in Table 1. The dry matter content of the processed *Waltheria indica* leaves was significantly affected by the different processing methods used. More dry matter reduction was observed in the FWIL (3.23) when compared to ensiled *Waltheria indica* leaves (EWIL) with (2.24). A similar dry matter loss in fermented *Senna obtusifolia* was reported by Augustine *et al.* (2018).

Table 1: Proximate composition of *Waltheria indica* leaves subjected to different processing methods

Proximate composition	T_1(SDWIL)	T_2(BFWIL)	T_3(EWIL)	SEM
Dry matter	92.18^a	89.20^c	90.11^b	4.71
% DM Reduction	0.00	3.23%	2.24%	
Crude Protein	17.61^c	19.36^b	21.69^a	6.67
% CP increase	0.00	9.37%	21.69%	
Crude fibre	15.08^a	12.51^c	14.75^b	4.71
% CF decrease	0.00	17.04%	21.90%	
Ether extract	3.82^a	3.15^b	2.86^c	2.34
% EE increase	0.00	17.54%	25.13%	
Ash	6.59^c	7.68^a	7.45^b	1.03
% ash decrease	0.00	16.54%	13.05%	
Nitrogen free extract	45.06^a	43.20^c	44.98^b	0.01
% NFE decrease	0.00	4.13%	0.16%	

Means of three replications.
a, b, c values with different superscripts on the same column are significantly different ($P< 0.05$).
FWIL- Fermented *Waltheria indica* leaves
EWIL- Ensiled *Waltheria indica* leaves
SDWIL- Shade dried *Waltheria indica* leaves (control)

The decrease in crude protein content was higher in the fermented *Waltheria indica* leaves BFWIL which recorded (21.69%) when compared to EWIL (9.37%). Both the BFWIL and EWIL recorded higher crude protein which is consistence with the report of Feng *et al*. (2007) and Ilyas *et al.* (1995) who pointed out that fermented feed contained more crude protein. This observation was because, during fermentation there was hydrolysis of protein enzyme tannin-complexes to release free amino acids for new protein synthesis. Fermentation is equally known to cause gradual increase in crude protein content of the feeds (Augutine *et al.,* 2018).

A reduction in the crude fibre content of the BFWIL and EWIL were observed which is consistent with the report of Augustine *et al.* (2018) for fermented *Senna obtusifolia* seeds and Anthony and Babatunde (2014), who in a similar study, reported a

decrease in fibre content of fermented millet and soya beans. However, the BFWIL indicated the lowest crude fibre. This might be due to the combined effects of heat and microbial actions on the cellulose components of the leaves.

The Ash content was observed to fairly increase in the FWIL and EWIL which is in line with the findings of Adebowale and Maliki (2011) for fermented *Cajanus* cajan flour. This outcome is consistent with the report of Augustine *et al*. (2017) for fermented *Senna obtusifolia* seeds and Kasangi *et al*. (2010) for cowpea (*Vigna unguiculata)* leaves.

The percentage decrease for NFE was observed to be high in BFWIL (4.13%) and lower in the EWIL (0.16%). The decrease in the nitrogen free extract content for the sample fermented might be due to high utilization of energy by micro flora during fermentation as observed in earlier studies (Obiakor and Nwanekezi, 2009; Nnam, 1995) and also the impact of heat on the carbohydrate content of the leaves. The ether extract content of the BFWIL and FWIL were observed to decrease which is in agreement with the findings of Anthony and Babatunde (2014). The reduction was attributed to the utilization of the ether extract by fermenting microbes.

Mineral element content of *Waltheria indica* leaves subjected to different processing methods

The mineral content of processed WIL is presented in Table 2: The result revealed that WIL is rich in mineral content such as calcium, iron, potassium and magnesium. The mineral content of the processed leaves were significantly (P<0.05) affected by the different processing methods. The mineral components were observed to increase in both the BFWIL and EWIL. However, EWIL recorded the highest level of increase for the mineral content. The decrease obtained for the mineral content of BFWIL was attributed to the leaching out of some mineral into the boiling water consequently lowering the mineral content. Which is consistent with the findings of Nsa *et al*. (2011) for casto seeds. Moreover, the presence of mineral elements such as Mg, Zn and Fe in *Waltheria indica* plant also supports its use as immune enhancer.

Table 2: Mineral Element Content of *Waltheria indica* leaves subjected to different processing methods

Mineral Element	T_1(SDWIL)	T_2(FWIL)	T_3(EWIL)	SEM
Calcium (CA)	142.66_c	145.36^b	165.44^a	5.27
% increase	0.00	1.89%	15.97%	
Iron (Fe)	19.50^c	21.46^b	23.37^a	0.53
% increase	0.00	10.05%	19.85%	
Potassium (K)	129.78^c	132.11^b	134.35^a	9.21
% increase	0.00	1.79%	3.52%	
Magnesium (Mg)	180.07^c	185.65^b	186.61^a	0.01
% increase	0.00	3.10%	3.63%	
Phosphorus (P)	251.36^c	254.71^b	256.81^a	2.35
% decrease	0.00	2.53%	2.17%	
Sodium (Na)	61.00^c	64.54^a	62.96^b	5.3
% decrease	0.00	5.80%	3.25%	

means of three replications.
abc values with different superscripts on the same column are significantly different (P< 0.05).
FWIL- Fermented *Waltheria indica* leaf
EWIL- Ensiled *Waltheria indica* leaf
SDWIL- Shade dried *Waltheria indica* leaf (control)

Anti-nutritional factors of *Waltheria indica* leaves

The level of the anti-nutritional factors as affected by the different processing methods is shown in Table 3: The result revealed that boiling+fermentation and ensiling methods were effective in reducing the levels of the anti-nutrients observed with boiling+ fermentation recording the highest reduction. This reduction was connected to the combined effects of boiling and metabolic activities of the microbes during fermentation. The microorganism breakdown the carbon and nitrogen bond of the anti-nutritional factors and used them for their metabolic activities and this may denature of these metabolites. This finding is in agreement with the report of Augustine *et al.* (2017) who in a similar study observed same for fermented *Senna obtusifolia* seeds.

Table 3: Antinutrients Content of *Waltheria indica* leaves (g/100g) subjected to different processing methods.

Antinutrients	T_1(SDWIL)	T_2(FWIL)	T_3(EWIL)	SEM
Cyanide	0.49[a]	0.21[b]	0.21[c]	0.00
%increase	0.00	57.14%	57.14%	
Glycoside	0.63[a]	0.37[c]	0.39[b]	0.00
% decrease	0.00	41.27%	38.10%	
Oxalates	0.78[a]	0.43[b]	0.42[a]	0.06
% increase	0.00	44.87%	46.15%	
Phenols	7.55[a]	3.46[c]	4.03[b]	0.52
% decrease	0.00	54.17%	46.62%	
Phytates	0.68[a]	0.38[b]	0.35[c]	0.08
% increase	0.00	44.12%	48.52%	
Saponins	0.79[a]	0.37[c]	0.42[b]	0.07
% decrease	0.00	53.16%	46.84%	
Tannins	0.99[a]	0.42[b]	0.39[c]	0.00
% increase	0.00	57.56%	60.61%	

means of three replications.
abc values with different superscripts on the same column are significantly different (P< 0.05).
FWIL- Fermented *Waltheria indica* leaf
EWIL- Ensiled *Waltheria indica* leaf
SDWIL- Shade dried *Waltheria indica* leaf (control)

Conclusion and Recommendations

The findings of the study revealed that boiling+fermentation and ensiling WIL were effective in improving the nutritional profile of WIL and also in reducing the levels of the anti-nutritional factors. However, some nutrients such as ether extract and nitrogen free extract were more reduced in BFWIL but the level of depreciation did not adversely affect the nutritional properties of the leaves. Therefore, either boiling+fermentation can be used to process WIL.

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