EFFECT OF PROCESSING ON THE PROXIMATE AND PHYTOCHEMICAL COMPOSITIONS OF SUN-DRIED DANDELION (*Taraxacum officinale*) LEAF MEAL

***Grace I. Christopher, Emediong J. Udombon, Iko-obong E. Ekette and Loveday S. Okon**

Department of Animal, Akwa Ibom State University, Obio Akpa Campus, Akwa Ibom State, Nigeria
**Corresponding Author's Email: graceidiong@aksu.edu.ng*

Abstract
This study evaluated the proximate and phytochemical compositions of sun-dried Dandelion (*Taraxacum officinale*) leaf meal (DLM) subjected to blanching (1.5–4.5 minutes) and soaking (1–3 hours) to assess its potential as a livestock feed supplement. Proximate analysis revealed that crude protein (12.11–17.50%) and ether extract (1.64–4.50%) declined significantly ($p<0.05$) with prolonged blanching, while nitrogen-free extract increased (46.50–57.28%). Moisture content decreased with processing, but dry matter and gross energy remained stable. Metabolizable energy (2596.57–2666.35 kcal/kg) was highest in untreated controls. Phytochemical screening showed higher bioactive compound retention in ethanol extracts than aqueous extracts. Alkaloids, glycosides, saponins, tannins, flavonoids, and polyphenols were strongly present in controls but degraded with processing, particularly under extended blanching (B_3). Quantitative analysis confirmed significant losses ($p<0.05$): alkaloids (1.10% to 0.04%), flavonoids (1.50% to 0.03%), and polyphenols (3.00% to 0.05%) in B_3. Soaking (S_1) preserved more phytochemicals than blanching, suggesting lower temperature processing better retains nutraceutical value. The study concludes that sun-dried DLM is a nutritionally rich feed resource, but processing methods critically impact its composition. Unprocessed or short-duration soaking is recommended to maximize retention of proteins, lipids, and bioactive compounds, while prolonged blanching should be avoided due to nutrient leaching and thermal degradation. These findings support DLM's potential as a sustainable, low-cost feed supplement, provided optimal processing techniques are employed.

Keywords: *Taraxacum officinale,* Feed supplement, Proximate Composition, Phytochemicals

Introduction
The global expansion of livestock production is fueled by increasing demand for animal products. Nevertheless, a significant paradox persists: while consumption surges, many people particularly in developing nations such as Nigeria remain undernourished due to limited purchasing power and the high cost of animal-based food. According to the FAO, 40% of the global value of agricultural output is contributed by livestock. In addition, increasing food demand coupled with declining crop yields can drive up food prices, and when combined with income disparities, this may limit food access and reduce availability for low-income households (FAO, 2020; Pawlak and Kołodziejczak, 2020). This scenario highlights the urgent need for sustainable, low-cost strategies to make animal protein

more accessible and affordable in resource-constrained regions (Escudero *et al*., 2003; Erdaw and Beyene 2022).

Recent research has increasingly focused on identifying alternative feed resources that can reduce production costs while enhancing nutritional value (Christopher *et al*., 2019; Christopher *et al*., 2024). Among these, *Taraxacum officinale* (commonly called dandelion or "lion's tooth") emerges as a promising candidate. An herbaceous plant with global distribution DLM and other plants have long been valued in traditional medicine and forage systems (Ekpo *et al*., 2022; Ghaly and Alkoik, 2012; Qureshi *et al*., 2016; Usoro *et al*., 2025).

Study by Martinez *et al*. (2015) have demonstrated that the proximate composition of dandelion leaf meals includes appreciable levels of crude protein, fiber, and essential minerals (iron, manganese, calcium, potassium), positioning it as a potentially valuable feed supplement. Furthermore, sun- or shade-dried leaves retain high concentrations of phytochemicals such as flavonoids (including quercetin), phenolic acids, β-carotene, vitamin C, chlorophyll, and unsaturated fatty acids, which contribute both nutritional and antioxidant properties (Maryyam *et al.*, 2024).

Despite these promising attributes, there remains a paucity of research specifically evaluating sun-dried dandelion leaf meal as a livestock feed additive, particularly in the context of its combined proximate nutritional profile and phytochemical composition.

Objective

This study aimed to evaluate the effects of different processing methods (blanching and soaking) on the proximate composition and phytochemical profile of sun-dried dandelion (*Taraxacum officinale*) leaf meal (DLM) with a view to assessing its potential as a sustainable, nutritionally enhanced feed supplement for livestock.

Materials and Methods

Study Area

The experimental work was carried out at the Akwa Ibom State University Central Laboratory Obio Akpa Campus of Akwa Ibom State University (AKSU), situated within the geographical coordinates of approximately 4°30′ to 5°00′ North latitude and 7°30′ to 8°50′ East longitude. This region is characterized by a humid tropical climate, with an annual rainfall ranging from 3,500 mm to 5,000 mm. The average monthly temperature hovers around 25°C, while relative humidity fluctuates between 60% and 90%, creating suitable conditions for agricultural and botanical research (Akwa Ibom State Government, 2024).

Source and Preparation of Dandelion (*Taraxacum officinale*) Leaf Meal

Fresh dandelion leaves (*Taraxacum officinale*), commonly referred to as dandelion or lion's teeth, were obtained from a cultivated pasture plot, Akwa Ibom State University in Obio Akpa Community, Oruk Anam Local Government Area, Akwa Ibom State, Nigeria. Immediately after collection, the leaves were thoroughly rinsed under clean running tap water to remove adhering soil particles and other extraneous materials.

The washed leaves were drained and subsequently divided into three experimental groups.

The first group (800 g) was chopped into smaller pieces using a clean kitchen knife and sun-dried on a corrugated roofing sheet. The second group (2,400 g) was further divided into three subgroups of 800g, each immersed in 8 litres of boiling water contained in separate pots. Immediately after immersion, the heat source (gas burner) was switched off, and the leaves were stirred briefly before being removed at intervals of 1minute 30seconds, 3minutes, and 4minutes 30seconds, respectively, and then drained. The third group (2,400 g) was likewise divided into three subgroups of 800g, each soaked in 8 litres of clean water for 1, 2, and 3 hours, respectively, drained before being spread on a corrugated roofing sheet for sun-drying over a five-day period.

Once fully dried, the plant material was pulverized into a fine powder using an electric blender (Kenwood brand, United Kingdom). The resulting dandelion leaf meal was stored in clean, airtight plastic containers to preserve its quality prior to laboratory analysis.

Proximate Analysis of Dandelion leaf meal

The nutritional composition of dandelion leaf meal was analyzed to determine its contents of crude protein, ether extract, crude fibre, Nitrogen-free extract (NFE), ash, and moisture. All analyses were carried out using well-established standard procedures. The determination of crude protein, ether extract, ash, and moisture followed the methods recommended by the Association of Official Analytical Chemists (AOAC, 2019). Crude fibre content was assessed using the procedure described by Van Soest (1994), while the nitrogen-free extract was calculated by deducting the combined values of crude protein, ether extract, crude fibre, and ash from 100% (Pearson, 1976). The metabolizable energy (ME), gross energy (GE) of the proximately analyzed leaf meals were calculated using the formula: ME (kcal/kg) = (37 × %CP) + (81.8 × %EE) + (35.5 × %NFE): GE (kcal/g) =5.72×CP (%) +9.50×EE (%) +4.79×NFE (%) (Pauzenga, 1985).

Phytochemical Analysis of Dandelion leaf meal

A quantitative assessment of the phytochemical constituents in the dandelion leaves was performed to identify and measure the levels of key bioactive compounds, including alkaloids, glycosides, saponins, tannins, flavonoids, reducing sugars, polyphenols, and phlobatannins. The analytical techniques used in this evaluation were based on the established protocols described by (AOAC, 2019). Alkaloids and tannins were measured using standard procedures for plant secondary metabolites as described by Harborne (1998). Polyphenols were extracted with 80% methanol and quantified spectrophotometrically using the Folin–Ciocalteu method (Harborne, 1998). Glycosides, flavonoids, and phlobatannins were analyzed according to the methods outlined by Trease and Evans (2002), while saponins and other reducing components were determined following the procedures of Sofowora (2008).

Study Design and Treatments

The study was arranged in a completely randomized design (CRD) and all analyses were done in triplicates. There were seven treatment groups. Treatment 1, which was the control, received no processing treatment. Treatment 2, 3, and 4 received different blanching times: 1 minute 30 seconds, 3 minutes, and 4 minutes 30 seconds, respectively; while treatments 5, 6, 7 were soaked in clean tap water for 1, 2, 3 hours, respectively.

Statistical analysis

All the data were subjected to analysis of variance (ANOVA) using the SPSS (2004) statistical software package. Significant means were separated using Duncan's Multiple Range Test (DMRT) (Duncan, 1955).

Results and Discussion

Results

Proximate Composition of Dandelion leaf meal

The crude protein (CP) content did not differ significantly across treatments ($p > 0.05$), although numerical variations were observed, ranging from 12.11% in B_3 to 17.50% in the control group (Table 1). Ether extract (EE) showed significant variation ($p < 0.05$), with the control having the highest value (4.50%) and B3 the lowest (1.64%). Crude fibre (CF) also exhibited slight but statistically significant differences ($p < 0.05$), with values ranging from 12.30% to 13.00%. Similarly, ash content decreased significantly ($p < 0.05$) as processing temperature increased, with the control and B_3 recording 6.00% and 5.07%, respectively.

A significant increase ($p < 0.05$) in Nitrogen-Free Extract (NFE) was noted across treatments, from 46.50% in the control to 57.28% in B_3. Dry matter (DM) content ranged between 87.50% and 88.40%; however, the differences were not statistically significant ($p > 0.05$), despite slight numerical changes. Moisture content, on the other hand, varied significantly ($p < 0.05$), with the highest value observed in the control (12.50%) and the lowest in B3 (11.60%).

Gross energy (GE) values ranged from 3.58 to 3.66 kcal/g, with no significant differences detected among treatments ($p>0.05$), though minor numerical variations were present. In contrast, metabolizable energy (ME) showed significant differences ($p < 0.05$), with values ranging from 2596.57 kcal/kg in B_2 to 2666.35 kcal/kg in the control

Qualitative Phytochemical Composition of Dandelion leaf meal

The results of the qualitative phytochemical screening (Table 2) revealed the presence of various bioactive compounds in both ethanol and aqueous extracts of dandelion. Alkaloids were strongly present (++) in the ethanol extract and moderately present (+) in the aqueous extract. However, a reduction in intensity was observed with increasing blanching time, with complete absence in B_3 aqueous extract (– –). Soaking also showed decreasing trend, with only weak presence in aqueous extracts of S_1 and none in S_2 and S_3. Glycosides were moderately present in control samples and varied inconsistently across treatments. Ethanol extracts of B_2 and

S_2 showed absence (– –), while aqueous extracts of control and S_1 recorded stronger reactions (++). Saponnin and tannins were detected in the ethanol extract of the control and S_1, but absent (– –) in all aqueous extracts and other treatments. Flavonoids showed strong presence (++ or +) in ethanol extracts of control, B_1, and S_1. Aqueous extracts generally lacked flavonoids, especially under blanching treatments, reducing compounds were strongly present (++) in the ethanol extract and moderately present (+) in the aqueous extract. Polyphenols remained present (++, +) in ethanol extracts across most treatments except B_3. Aqueous extracts showed moderate presence (+) in control and S_1, but were absent in prolonged processing. Phlobatanins were detected only in the ethanol extract of the control, S_1, and S_2 (+), but absent in all aqueous extracts and in all blanched samples,

Quantitative Phytochemical Composition of Dandelion leaf meal

The phytochemical constituents (Table 3) of the differently processed dandelion leaf meal varied significantly across treatments ($p < 0.05$).

Alkaloid content was highest in the control ($1.10 \pm 0.17\%$) and declined markedly with processing. The lowest concentrations were recorded in the B_3 treatment ($0.04 \pm 0.01\%$) and in the soaked samples S_1 and S_3. Similarly, glycoside levels showed a decreasing trend with increased processing time, ranging from $1.40 \pm 0.36\%$ in the control to $0.04 \pm 0.02\%$ and $0.08 \pm 0.02\%$ in B_3 and S_3, respectively.

Saponin content was most pronounced in the control ($0.50 \pm 0.25\%$) and in S_1 ($0.30 \pm 0.01\%$), while significantly lower levels were observed in the extensively processed samples, particularly B_3, which showed a complete loss ($0.00 \pm 0.00\%$).

Tannins also decreased with processing, from $0.60 \pm 0.17\%$ in the control to undetectable levels in B_3. A moderate amount ($0.40 \pm 0.00\%$) was retained in S1, whereas extended soaking and blanching further reduced tannin content.

Flavonoid concentrations declined significantly across treatments. The control recorded the highest level ($1.50 \pm 0.40\%$), while B_3 exhibited the lowest ($0.03 \pm 0.01\%$). Among the processed groups, S1 retained a relatively high level ($1.20 \pm 0.01\%$), while B_2 and S_2 dropped to $0.70 \pm 0.02\%$ and $0.77 \pm 0.06\%$, respectively.

Reducing compounds followed a similar pattern, decreasing from $1.40 \pm 0.20\%$ in the control to $0.01 \pm 0.01\%$ in B_3. The S_1 sample retained higher levels ($1.30 \pm 0.02\%$) compared to the other processed groups.

Polyphenol content was significantly influenced by the treatments ($p < 0.01$), ranging from $3.00 \pm 0.25\%$ in the control to $0.05 \pm 0.03\%$ in B_3. A considerable amount ($2.18 \pm 0.02\%$) was maintained in S_1, while intermediate reductions were observed in the remaining treatments.

Phlobatannin levels were highest in the control ($2.80 \pm 0.17\%$) and declined progressively with processing. The lowest value was noted in B_3 ($0.04 \pm 0.02\%$), while S_1 preserved a relatively high concentration ($2.01 \pm 0.02\%$).

Table 1: Proximate composition of Dandelion leaf meal

Parameters (%)	Control	B_1	B_2	B_3	S_1	S_2	S_3	P value
CP	17.50 ±0.11	16.03± 0.51	13.01± 0.11	12.11±0.12	17.03± 0.09	16.36±0.16	14.97± .11	0.135
EE	4.50 ± 0.09^{a}	3.70± 0.05^{b}	2.04± .06^{d}	1.64±0.05^{e}	4.16± 0.04^{a}	3.80±0.06^{b}	3.18± 0.02^{c}	0.000
CF	13.00±0.20^{a}	12.88±0.08^{ab}	12.73± .12^{bc}	12.30±0.08^{c}	12.98±0.02^{a}	12.80±0.07^{ab}	12.76±0.10^{b}	0.000
ASH	6.00 ± 0.05^{a}	5.58± 0.02^{b}	5.32 ± 0.05^{c}	5.07± 0.02^{d}	5.93± 0.05^{a}	5.69± 0.07^{b}	5.55 ±0.04^{bc}	0.000
NFE	46.50±0.50^{e}	49.82±0.57^{d}	55.07±0.32^{b}	57.28± .35^{a}	47.60±0.58^{e}	49.27±0.28^{d}	51.48± 0.30^{c}	0.000
DM	87.50± 0.10	88.00± 0.00	88.17± 0.09	88.40± 1.59	87.70±0.08	87.89±0.09	87.94±0.10	0.550
Moisture	12.50±0.10^{a}	12.00±0.00^{b}	11.83±0.09^{c}	11.60± .09^{c}	12.30±0.08^{ab}	12.11±0.09^{ab}	12.06±0.10^{ab}	0.001
GE (kcal/g)	3.66±0.05	3.66±0.06	3.58±0.03	3.59 ± 0.04	3.65 ± 0.06	3.66 ± 0.03	3.62 ± 0.03	0.411
ME (kcal/kg)	2666.35 ± 0.50^{a}	2657.29 ± 0.57^{bc}	2596.57 ± 0.32^{d}	2661.93 ± 0.35^{ab}	2661.38 ± 0.58^{ab}	2640.29 ± 0.28^{c}	2604.91 ± 0.30^{d}	0.000

^{abcdef} means on the same row bearing various superscripts are significantly different ($p<0.05$);
B_1=blanched 1minute 30 seconds; B_2=blanched 3minutes; B_3=blanched for 4 minutes 30 seconds;
S_1=Soaked for 1hour; S_2=Soaked for 2 hours; S_3=Soaked for 3 hours.

Table 2: Qualitative Phytochemical screening of ethanol extract and aqueous extract from processed Dandelion leaf meal

	Processing method						
	Control	B_1	B_2	B_3	S_1	S_2	S_3
Alkaloids	a. ++	a. +	a. +	a. –	a. ++	a. +	a. +
	b. +	b. –	b. –	b. – –	b. +	b. –	b. –
Glycosides	a. +	a. –	a. – –	a. – –	a. +	a. –	a. –
	b. ++	b. +	b. –	b.– –	b. ++	b. +	b. +
Saponin	a. +	a. –	a. – –	a. – –	a. +	a. –	a. –
	b. –	b. – –	b. – –	b. – –	b. –	b. –	b. – –
Tannins	a. +	a. –	a. – –	a. – –	a. +	a. –	a. –
	b. – –	b. – –	b. – –	b. – –	b. – –	b. – –	b. – –
Flavonoid	a. ++	a.+	a. +	a. –	a. ++	a. +	a. +
	b. –	b. – –	b. – –	b. – –	b.–	b. –	b. – –
Reducing compound	a. ++	a. +	a. +	a. –	a. ++	a. +	a. +
	b. +	b. +	b. –	b. – –	b. +	b. –	b. –
Polyphenols	a.++	a. +	a. +	a. –	a. ++	a. +	a. –
	b. +++	b. ++	b. +	b. –	b. +++	b. ++	b. +
Phlobatannins	a. +	a. –	a. – –	a. – –	a.+	a. +	a.
	b. –	b. – –	b. – –	b. – –	b. –	b. –	b. –

Note. a.-=ethanol extract; b. = aqueous extract; +++ = Very strongly present; ++ = Strongly present; + = Weakly present; – = Weakly absent; – – = Not detectable. B_1=blanched 1minute 30 seconds; B_2=blanched 3minutes; B_3=blanched for 4 minutes 30 seconds; S_1=Soaked for 1hour; S_2=Soaked for 2 hours; S_3=Soaked for 3 hours.

Table 3: Phytochemicals composition of the differently processed Dandelion leaf meal

	Processing method							
Parameter	Control	B_1	B_2	B_3	S_1	S_2	S_3	P-value
Alkaloids	1.10±0.17^{a}	0.90±0.00^{a}	0.50 ± 0.35^{b}	0.04 ± 0.01^{d}	0.08±0.0^{d}	0.40± 0.01^{c}	0.06 ± 0.02^{d}	0.000
Glycosides	1.40±0.36^{a}	1.00±0.17^{a}	0.30 ± 0.17^{c}	0.04 ± 0.02^{d}	1.10 ± 0.01^{a}	0.70 ± 0.02^{b}	0.08 ± 0.02^{d}	0.000
Saponins	0.50±0.25^{a}	0.10±0.01^{c}	0.02 ± 0.02^{c}	0.00 ± 0.00^{c}	0.30 ± 0.01^{b}	0.10 ± 0.02^{c}	0.05 ± 0.02^{c}	0.000
Tannins	0.60±0.17^{a}	0.09±0.02^{cd}	0.03 ± 0.03^{d}	0.00 ± 0.00^{d}	0.40 ± 0.00^{b}	0.20 ± 0.02^{c}	0.07 ± 0.02^{d}	0.000
Flavonoids	1.5±0.40^{a}	1.08±0.03^{b}	0.70 ± 0.02^{c}	0.03 ± 0.01^{d}	1.20 ± 0.01^{b}	0.77 ± 0.06^{c}	0.06 ± 0.03^{d}	0.000
Reducing Compounds	1.40±0.20^{a}	1.09±0.03^{b}	0.60 ± 0.02^{c}	0.01 ± 0.01^{d}	1.30 ± 0.02^{a}	0.70 ± 0.02^{c}	0.05 ± 0.03^{d}	0.000
Polyphenols	3.00± 0.25^{a}	1.60±0.01^{c}	0.90 ± 0.02^{d}	0.05 ± 0.03^{e}	2.18 ± 0.02^{b}	1.60 ± 0.02^{c}	0.08 ± 0.02^{e}	0.009
Phlobatannins	2.80±0.17^{a}	1.40±0.01^{c}	0.70 ± 0.00^{d}	0.04 ± 0.02^{f}	2.01 ± 0.02^{b}	1.37 ± 0.06^{c}	0.55 ± 0.03^{e}	0.000

^{abcdef} mean on the same row bearing various superscripts are significantly different ($p<0.05$); B_1=blanched 1minute 30 seconds; B_2=blanched 3minutes; B_3=blanched for 4 minutes 30 seconds; S_1=Soaked for 1hour; S_2=Soaked for 2 hours; S_3=Soaked for 3 hours.

Discussion

Proximate Composition of Dandelion Leaf Meal

The crude protein (CP) content of the differently processed dandelion leaf meals ranged from 17.50 % in the control sample to 12.11 % in the B_3 treatment. Although a numerical decline in CP was observed with prolonged blanching (notably in B_2 and B_3), this reduction was not statistically significant ($p > 0.05$). Soaking treatments (S_1 – S_3), conducted at ambient or lower temperatures, maintained relatively higher CP levels compared to the heat-intensive blanching methods, suggesting that, non-thermal processing better preserves protein content.

The ether extract (EE) content declined significantly ($p < 0.05$) with processing. It reduced from 4.50 % in the control to 1.64 % in B_3. This significant loss is attributed to lipid leaching into the blanching water and possible oxidation of fats during thermal exposure, a common trend in thermally processed leafy materials (Maila and Tseke, 2024).

Crude fibre (CF) content also showed a significant variation ($p < 0.05$), ranging from 12.30 % to 13.00 %. Slight decreases were recorded in the blanched samples, possibly due to partial solubilization of hemicellulose and other fibrous cell wall components as recorded by (Maila and Tseke, 2024: Udombon *et al*., 2025a). However, these differences were less marked than those observed in EE content.

Ash content experienced a significant reduction ($p < 0.05$) with increased blanching time. It decreased from 6.00 % in the control to 5.07 % in B_3, likely due to mineral leaching into the blanching water, consistent with findings in other leafy greens (Mugo *et al.*, 2024).

The nitrogen-free extract (NFE) content increased significantly ($p < 0.05$) in the blanched samples. The highest value

(57.28 %) was recorded in B_3, compared to 46.50 % in the control. This is likely due to the proportional increase in carbohydrate content following losses in protein and lipid fractions.

The dry matter (DM) content ranged from 87.50 % to 88.40 %, with numerical increase in blanched samples. However, this change was not statistically significant ($p > 0.05$). In contrast, moisture content decreased significantly ($p < 0.05$), reflecting the effect of heat treatment in reducing water retention and increasing tissue dryness, as noted by Sarkar *et al*. (2021).

Gross energy (GE) values ranged between 3.58 and 3.66 kcal/g, with no significant difference ($p > 0.05$) among the treatments. However, metabolizable energy (ME) values, which ranged from 2596.57 to 2666.35 kcal/kg, showed a significant difference ($p < 0.05$). The control and lower temperature treatments (S_1 and S_2) retained significantly higher ME values than the prolonged blanching treatments (B_2 and B_3), likely due to nutrient degradation from intense thermal processing (Maila and Tseke, 2024).

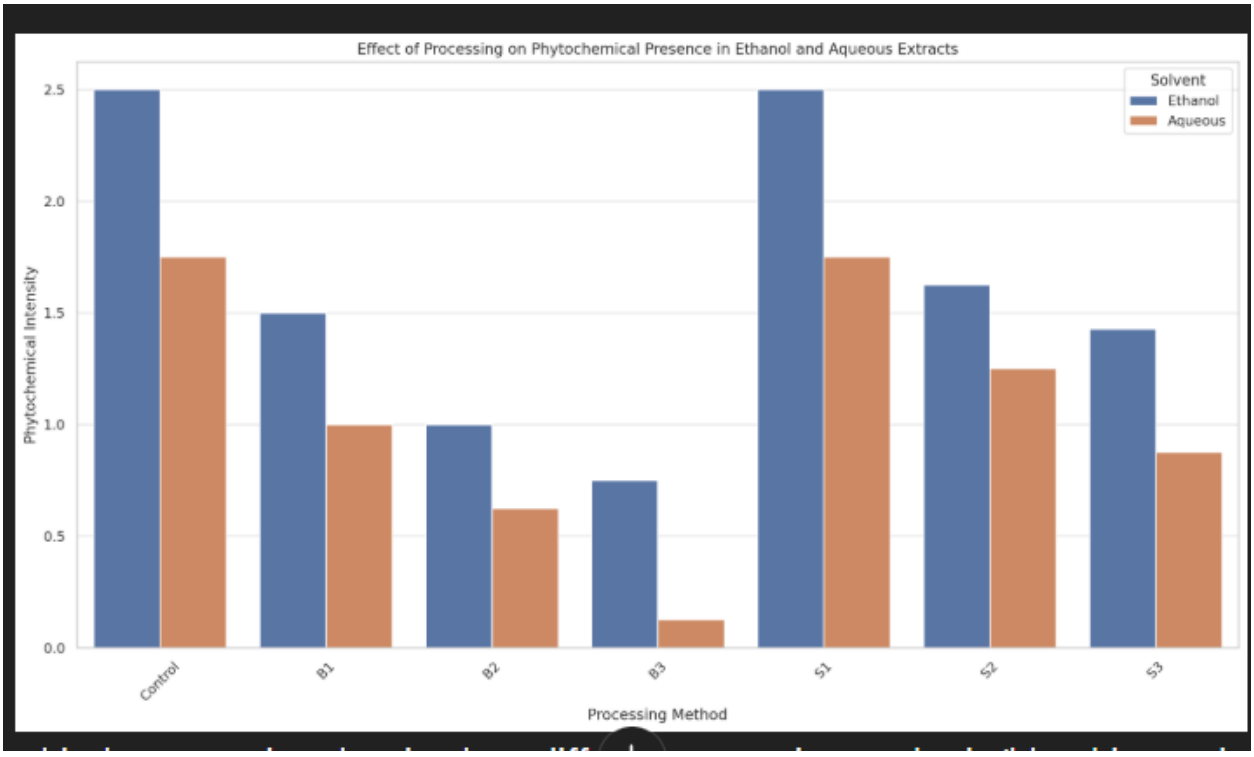

Figure 1: Effect of Processing on Phytochemical Presence in Ethanol and Aqueous Extracts of Dandelion Leaf Meal

The bar chart deduced from Table 2 shows the effect of different processing methods on the presence of phytochemicals in ethanol and aqueous extracts of dandelion leaf meal (Figure 1). Generally, ethanol extracts from this study had higher levels of bioactive compounds than aqueous extracts across all treatments in agreement with report by Christopher (2025).

Processing reduced phytochemical intensity, with blanching causing the most significant decline, especially after prolonged exposure (B_3). This was more evident in aqueous extracts, likely due to heat-sensitive compounds being lost through leaching and degradation (Narra *et al.,* 2024).

Soaking also led to gradual reductions, though the impact was less severe compared to blanching. Among all treatments, control samples had the highest phytochemical content, confirming that processing diminishes the concentration of key bioactives. Vincenzo *et al*. (2020) reported similar degradation patterns of bioactive compounds during processing.

Phytochemical Composition of Dandelion Leaf Meal

The phytochemical composition of the experimental dandelion leaf meal (DLM) showed statistically significant differences ($p < 0.05$) across the various processing treatments, as presented in Table 3. The evaluated phytochemicals included alkaloids, glycosides, saponins, tannins, flavonoids, reducing compounds, polyphenols, and phlobatannins. The results indicate that processing methods, particularly blanching and soaking, substantially influenced the concentration and retention of these bioactive constituents.

Alkaloids

Alkaloid concentration was highest in the unprocessed control sample (1.10%), but significantly decreased with processing, especially in the prolonged blanching (B_3) and soaking (S_3) treatments, which recorded the lowest values (0.04% and 0.06%, respectively). This reduction is likely due to the heat sensitivity of alkaloids and their tendency to leach into water during thermal and aqueous treatments. Vincenzo *et al*. (2020) in their study, reported similar degradation patterns of alkaloids during processing.

Glycosides

Glycoside levels were highest in the control and in the shorter time of blanching treatment B_1 (1.40%), but significantly ($p < 0.05$) declined with extended blanching time (B_3) and soaking (S_3), where levels dropped to 0.04%. This reduction is attributed to leaching into water and possible enzymatic hydrolysis during prolonged exposure to heat and moisture, consistent with the findings of Šola *et al*. (2023).

Saponins

Processing also led to a significant decline ($p < 0.05$) in saponin content. The control contained 0.50%, while B_3 had undetectable levels (0.00%). The marked reduction in saponins is likely due to their high-water solubility and susceptibility to thermal breakdown during blanching, as documented by Narra *et al.* (2024).

Tannins

Tannin concentration followed a similar trend, with the control recording the highest level (0.60%). In contrast, significantly lower levels were observed in B_3 (0.00%) and S_3 (0.07%). This decline may be due to the solubility of tannins in water and their tendency to leach out during thermal and soaking processes. These findings are supported by Sarkar *et al.* (2021), who noted tannin losses in blanched leafy vegetables.

Flavonoids

The highest flavonoid content was found in the control (1.50%), followed by S1 (1.20%) and B_1 (1.08%). These results suggest that lower processing temperature retains more flavonoids, likely due to limited disruption of plant cell walls. However, high processing temperature, especially B_3, resulted in a significant decline (0.03%), presumably due to leaching and degradation of flavonoids in hot water. Maila & Tseke (2024) observed similar trend.

Reducing Compounds

High concentrations of reducing compounds were observed in the control (1.40%) and S1 (1.30%). In contrast, B_3 and S_3 showed significantly lower values (0.01% and 0.05%, respectively). This decrease may be attributed to the thermal sensitivity and solubility of these compounds, leading to losses during blanching and soaking. Nobosse *et al*. (2017) and Udombon *et al.* (2025b) had noted that reducing compounds, which are typically phenolic in nature, contribute to antioxidant activity but are often lost during thermal treatments, as noted

Polyphenols

A substantial reduction in polyphenol content was observed in processed samples. The control recorded the highest value (3.00%), whereas B3 and S3 had the lowest (0.05% and 0.08%, respectively). This significant ($p<0.05$) decrease is attributed to the water solubility of polyphenols and their leaching during blanching. Korus and Lisiewska (2011) similarly reported a decline in polyphenol levels following hot water treatments of leafy vegetables.

Phlobatannins

Phlobatannin levels decreased significantly with processing. The control sample contained 2.80%, while B3 recorded the lowest value (0.04%). The reduction can likely be as the result of leaching and heat-induced degradation. According to Christopher (2025) and Mussa *et al*. (2024), phlobatannin a group of condensed tannins with known antioxidant and antimicrobial properties are highly susceptible to thermal degradation. Magangana *et al*. (2022) further explained that blanching inactivates enzymes like polyphenol oxidase, facilitating the leaching of phenolic compounds, including phlobatannins.

Conclusion

This study demonstrated that sun-dried dandelion leaf meal (DLM) possesses appreciable nutritional and phytochemical value, making it a viable candidate for livestock feed supplementation. The proximate analysis revealed that blanching, especially for extended durations (4.5 minutes), significantly reduced crude protein, ether extract, and ash content due to thermal degradation and leaching, while increasing

nitrogen-free extract. Soaking treatments, particularly for 1 hour (S1), better preserved these nutrients, suggesting that non-thermal methods are less detrimental to nutritional quality.

Phytochemical screening highlighted the sensitivity of bioactive compounds to processing. Ethanol extracts retained higher concentration of alkaloids, flavonoids, and polyphenols than aqueous extracts, but both showed marked declines with prolonged blanching. Quantitative data confirmed near-complete loss of saponins, tannins, and phlobatannins in B_3, while S_1 maintained intermediate levels. This aligns with literature on heat-induced degradation of phytochemicals and underscores the trade-off between processing (e.g., anti-nutrient reduction) and nutrient retention.

For practical applications, unprocessed and short-duration soaking is recommended to balance nutrient preservation and anti-nutrient mitigation. Future research should explore hybrid processing techniques (e.g., shorter blanching time followed by soaking) and in vivo trials to validate DLM's efficacy in livestock diets. Overall, DLM would offer a sustainable, cost-effective feed resource, but its benefits are highly dependent on processing protocols.

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