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Climate-Adapted Circular Poultry Production: Salt-Treated Wild Yam Tubers as Sustainable Supplementary Feed Ingredients Via Osmosis-Based Detoxification

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Authors' contributions

This work was carried out in collaboration between both authors. Author ET did research design, concept and corresponding author. Author SC did data gathering, analysis and article preparation. Both authors read and approved the final manuscript.

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ABSTRACT

Wild yams have tremendous potential as nutritious food and feed sources. However, anti-nutritional factors like oxalates and phenolics limit their utilization. This study evaluated salt-assisted osmosis for detoxification and nutritional improvement of wild yam tubers and assessed their application as a feed ingredient for native chickens. Wild yam tubers were treated with 10%, 20%, and 30% salt solutions to induce osmosis-based leaching of water-soluble toxins. Proximate analyses confirmed

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nutrient retention post-treatment. Four isonitrogenous experimental chicken feeds were formulated with varying proportions of standard commercial diet and salt-treated wild yam meal. Ninety-six 5-week-old native chicks were randomly allocated to the diets for 8 weeks to assess growth performance, intake, meat quality, and physiological parameters. Toxin levels decreased up to 50% with a 30% salt solution while beneficial nutrients were preserved. The inclusion of treated yam meal did not adversely affect growth rate, though higher salt levels reduced feed palatability. Carcass traits remained unaffected although minor organ weight and serum biomarker changes indicated physiological stress. Salt-assisted osmosis the demonstrates potential for efficient detoxification to promote better utilization of under-explored nutritious crops like wild yam as sustainable, alternative feed sources without compromising nutritional adequacy. Further optimization to prevent anti-nutrient reaccumulation and physiological imbalance is recommended before scalability for food/feed security.

Keywords: Anti-nutritional factors; detoxification; native chickens; osmosis; salt treatment.

1. INTRODUCTION

Climate change threatens staple crop production, necessitating climate-resilient alternatives like underutilized wild yams. However, anti-nutrients limit the nutritional utilization of this hardy tuber. Our climate-adapted circular agricultural approach uses salt-assisted osmosis to sustainably detoxify wild yams, enhancing their application as supplementary poultry feed.

Wild yam (*Dioscorea hispida* Dennst) thrives with little to no inputs under erratic rainfall and marginal soils. However nutritional utilization is restricted due to anti-nutrients like oxalates, tannins, and cyanogens that reduce bioavailability or palatability [1- 4]. Common processing methods risk leaching beneficial nutrients [5-7]. Chemical techniques also compromise safety [8, 9]. Osmosis offers selective diffusion-based extraction of water-soluble toxins by exposure to high salt concentrations, retaining nutrients better. Salt solutions facilitate toxin removal from wild yam slices via osmotic diffusion across intact membranes, preserving intracellular nutrients better [10]. Soaking tubers in 1-5% sodium chloride lowered cyanide levels by over 99% as water migrated out while cell structures remained intact [11]. This simple, affordable processing technology is readily scalable, providing climate resilience if environmental factors constrain the production of conventional crops [12].

Under-exploited crops like detoxified wild yams can sustainably supplement standard feeds. Rural smallholder production can support circular year-round poultry systems adapted for climate resilience. Evaluating native chicken performance on salt-treated wild yam diets can demonstrate nutritional suitability. Better utilization also provides livelihoods and food security co-benefits. Our approach aligns with circular economy principles using locally available, affordable resources while minimizing processing waste. Outcomes demonstrate sustainability across economic, environmental, and social dimensions amidst climate uncertainty.

2. MATERIALS AND METHODS

2.1 Trial Location

The study was conducted in accordance with ethical guidelines and approved by the institutional animal ethics committee of Surigao del Norte State University, Philippines. The experimental setup was housed at the poultry research facility of the Department of Animal Science, Surigao State College of Technology-Mainit Campus, Mainit, Surigao del Norte, Philippines. The facility is located in the rural locality of Mainit (9°52′N 125°42′E) with a tropical rainforest climate.

The open-sided poultry house measures 300 sq ft and contains rows of elevated wire mesh cages equipped with nipple drinkers and hanging feeders. Temperature and lighting are controlled to provide optimum conditions. Standard procedures are implemented for biosecurity, hygiene, and poultry husbandry as per Philippine National Standards. The feeding trial was conducted from October 2020 to January 2021. Locally sourced wild yam tubers were purchased from farmers in the region. Proximate analysis was performed at the Feed Analytical Laboratory in the Department of Agriculture, Regional Field Office XIIC, Butuan City, Philippines using standard methods.

Table 1. Proximate nutritional composition of the tubers of wild yam (raw) and salt-treated wild yam meal at 10%, 20%, and 30 % salt concentration

Parameter	WY10	WY 20	WY 30	WY - Raw
Crude protein %	4.38	4.35	4.36	4.38
Crude fiber %	2.76	2.76	2.74	2.75
Crude fat %	0.24	0.21	0.21	0.24
Calcium	0.30	0.30	0.32	0.31
Phosphorus	0.07	0.07	0.08	0.07

WY – Wild Yam; 10, 20, and 30 - Concentration of salt at brining

2.2 Preparation of Wild Yam and Osmosis Procedure

Fresh wild yam tubers were harvested locally and purchased from local farmers. The tubers were thoroughly washed under running water to remove adhering soil and debris. Damaged, bruised, or decayed tubers were discarded. The peel was manually removed using stainless steel knives and the remaining tissue was sliced into 5mm thick chips using a mechanical slicer sterilized with 70% ethanol between batches.

The sliced chips were immediately subjected to an osmosis procedure in food-grade plastic containers. 10 kg batches of chips were treated with 10%, 20%, and 30% w/v analytical grade NaCl granule. The containers were stirred intermittently and held at ambient temperature (25±3°C).

for 72 hours. The wild yam chips were then removed and washed thoroughly with potable water to remove surface salt. The chips were then dehydrated in a mechanical dehydrator at 40°C for 48 hours followed by milling to a fine powder using a hammer mill fitted with a 1.6mm screen. The wild yam powder samples were collected separately, sealed in high-density polyethylene pouches, and stored at 4°C until further analysis.

2.3 Diet and Experimental Chickens

Four isocaloric and isonitrogenous experimental diets were formulated with similar ingredients and nutrient levels as per NRC standards for poultry [13]). The control diet (T1) commercial, and the treatment diets (T2, T3 & T4) consisted of a 70% control diet supplemented with 30% wild yam meal powder treated previously with 10%, 20%, and 30% sodium chloride solution respectively using the optimized osmosis procedure. Ninety-six, day-old "Bisaya" native chicks (*Gallus gallus domesticus*) procured from a certified local breeder were randomly assigned to four dietary treatment groups with 4 replicates per group and 6 chicks per replicate following a completely randomized design (CRD). The straight-run chicks with an initial average body weight of 238 ± 8 g were housed in screen battery cages with *ad libitum* access to feed and water. Lighting, ventilation, temperature, vaccination, and other husbandry practices were controlled as per recommended guidelines throughout the 8-week feeding trial. Growth performance parameters such as feed intake, body weight gain, feed conversion, ratio and protein efficiency ratio were regularly monitored. At the end of the trial, six birds from each group were randomly selected, starved overnight, and slaughtered humanely prior to analysis of carcass characteristics, organ weights, and meat quality attributes.

2.4 Data Collection

Body weight was recorded at the start of the feeding trial and every two weeks after that. Daily records of the amount of water and feed given and the remaining amounts to measure water and feed intake were kept. The feed conversion ratio was determined by calculating the ratio of body weight growth to the amount of ingested feed. After the eight-week feeding experiment, all birds remaining from each replicate were taken off feed for 8 hours before being slaughtered at the Food Laboratory Unit of the College (Department of Animal Science). The carcass characteristics were measured after the birds were de-feathered and eviscerated. Body weight gain (BWG) was estimated using the formula.

$$Body\ Weight\ Gain\ (BWG) = \frac{Final\ Weight}{Initial\ Weight}$$

Nutrient utilization indices were expressed in terms of Feed Conversion Ratio (FCR) and Protein Efficiency Ratio (PER) as follows:

$$FCR = \frac{Total\ Feed\ Intake}{Weight\ Gain}$$

$$PER = \frac{Mean\ Weight\ Gain}{Protein\ Intake}$$

$$Where: Protein\ Intake = \frac{Total\ Feed\ Intake}{Protein\ Content\ of\ Feed}$$

The pH of meat (Pictorales Major) was measured in 0-, 24-, and 48-hour post-slaughter in triplicate by a Digital pH Meter (PH-108). The pH meter calibration was by Siekmann [14] procedure, and the pH of meat determination was according to the [15] method. Ten grams of ground meat were added with 100 ml of distilled water and blended for 30 seconds at high speed. Discharged the blended mixture into a glass and inserted the pH meter electrode. Cooking loss was determined by oven-cooking the 10g of meat at a maximum temperature of 150^0C for 1hr [15]). The formula calculates the percentage of cooking loss:

Cooking Loss %= Weight of Raw Meat-Weight of Cooked Meat / Weight of Raw Meat * 100

2.5 Statistical Analysis

All experimental data were subjected to the Shapiro-Wilk Test of normality to determine the normal distribution of data before the analyses of variance (ANOVA). A completely randomized design (CRD) was conducted using SPSS ver. 26 in the Windows package. The Tukey HSD test partitioned the Means, with a significance level set at P < 0.05.

3. RESULTS AND DISCUSSION

3.1 Anti-Nutritional Content

The results showed that salt treatment successfully reduced levels of total free phenolics, hydrogen cyanide, and total oxalates in wild yam tubers, with the highest decrease of 49.4%, 50%, and 31%, respectively, at 30% NaCl compared to raw tubers (Table 2). This aligns with Kresnadipayana & Waty's [11] findings where soaking gadung tuber slices for 72 hours in a 5% NaCl solution lowered cyanide content by over 99% via osmotic diffusion. Similarly, Estiasih [10] reported that traditional methods of rubbing wild yam tuber slices with ash and salt reduced cyanogenic glycosides, which are broken down into hydrogen cyanide and removed by heating. The removal of cyanides by salt soaking was achieved through a process known as osmosis. During the soaking, the free hydrogen cyanide (HCN) is attracted to the Na+ ion of the NaCl compound. This allows the cyanide to be removed from the cassava roots, reducing cyanide levels [16]. Soaking in a NaCl solution effectively reduces the oxalate content in purple yam, with the best results obtained at a 10% NaCl concentration, which reduced oxalate content by 22.89%. However, soaking does not affect the number and size of oxalate crystals or the size of the amylum [17].

Moreover, the NaCl soaking had a minimal impact on the total free phenolics of purple potato. In the study by Zhang [18] found that soaking in citric acid solutions had a greater effect on the color quality and phenolic content of the potato chips compared to NaCl soaking. The key mechanism involved seems to be salt-induced dehydration damaging cell membranes and causing intracellular fluid leakage, carrying water-soluble toxins out into the high osmolality medium [19]. This likely explains the incrementally greater effectiveness of higher NaCl concentrations. Beneficial nutrients are retained within the intact cells as confirmed through proximate analyses presented in Table 1. In summary, salt-driven osmosis likely enables selective toxin removal from wild yams, improving the palatability and bioavailability of nutrients. This green technique can build local and global resilience to nourish people if staple crop yields decline under climate pressures.

3.2 Feed Intake

Table 3 presents that salt concentration in the wild yam meal significantly affected chicken feed intake, especially during the grower phase (weeks 1-4). In weeks 1-2, feed intake was lowest for 30% salt-treated wild yam (WY30), differing significantly from the commercial diet (CD). Similarly in weeks 3-4, intake was lowest for WY20 and WY30 compared to CD and 10% salt wild yam (WY10). This aligned with previous studies showing that anti-nutritional factors can reduce diet palatability and feed consumption. The wild yam is a type of root crop that contains acrid oxalates. These oxalates have been found to bind to essential minerals, which can reduce their bioavailability. Studies conducted by Bhandari & Kawabata [20] and Padhan et l. [21] have revealed that the anti-nutrients present in wild yams can lead to a reduced feed intake. These findings have been corroborated by Woyengo et al. [22]. However, it remains unclear whether the concentration of oxalates in the wild yam meal used in the study was high enough to affect nutrient absorption and utilization by the chickens. It is worth noting that the 30% salt-treated wild yam (WY30) group had the lowest feed intake, even though salt treatment significantly reduced anti-nutrients such as oxalates. This could be attributed to a few potential reasons. Firstly, while oxalate levels decreased due to osmosis-driven leaching, the final residual content may still have been sufficient to bind minerals like calcium and reduce feed palatability and efficiency. This could have resulted in a lower intake of feed by the WY30 group. Secondly, high dietary salt can independently influence feed intake. Salt treatment may have led to the leaching of some beneficial nutrients and bioactive compounds alongside anti-nutrients due to non-selective diffusion. As a result, this could have reduced the flavor, aroma, and taste incentives driving feed consumption.

The impact of a high salt diet on the feed intake of chickens has been the subject of extensive research, and the findings are mixed. While some studies have reported a depressed feed intake but improved feed conversion ratio in broiler chickens [23], others have shown a significant reduction in food acquisition and body weight gain for salt-treated compared to the control group [24]. On the other hand, certain investigations have suggested an improved feed intake and body weight gain of chickens supplemented with non-chloride sodium salts [25]. Several factors, such as the type and concentration of salt used and the duration of the saline intervention, may have contributed to the varying outcomes of different studies. It is worth mentioning that adding salts of organic acids to the diet has been found to improve the productivity and feed conversion ratio without affecting the amount of feed eaten. In summary, while high salt concentrations are effective in toxin removal, they seem to negatively impact feed intake via other mechanisms in chickens fed osmosis-treated wild yam diets.

During the finisher phase, which typically lasts for weeks 5-8, no significant differences in feed intake were observed among the different groups of chickens. This implies that the birds were able to adapt to their respective diets over time. The result implies that younger chickens may be more susceptible to the negative effects of anti-nutrients and salt content in their feed. However, as they mature, their gut function and microbial profile improve, which enables them to maintain their feed intake regardless of the type of feed provided.

3.3 Water Intake

Table 4 presents data that suggests that older chickens tend to consume more water than younger ones. The observed groups of chickens exhibited varying levels of water intake, with the WY10 group consuming significantly more water than the other groups. On the other hand, the CD group had the lowest intake of water. The difference in water intake levels between the groups was statistically significant at a *P*-value less than .05. Therefore, the composition of the diet, which includes wild yam and salt, can significantly affect the water consumption of chickens. One possible explanation for the increased water intake of the salt-treated wild yam group is that the chickens needed hydration and toxin flushing. Anti-nutritional factors (ANFs) present in animal feed can cause intestinal inflammation, diarrhea, and dehydration, leading to increased water absorption and eventually water loss through feces, urine, and vapor from the skin [26]. The urge to drink and prevent dehydration is stimulated by homeostatic feedback mechanisms. These mechanisms maintain proper hydration levels [27, 28]. Furthermore, high dietary salt levels can also impact chickens' water intake and excreta moisture content. When chickens ingest high levels of sodium, they drink more water to restore hydromineral balance [29]. Excessive salt intake prompts the kidneys to filter out excess salt, which requires more water. Maintaining the water-salt balance is vital to ensure proper electrolyte balance for optimal bodily function. Increased salt levels stimulate water intake and urine production [30]. For example, rams fed a high-salt diet showed lower live weight gains, increased water intake, smaller testes, and reduced sperm quality [31]. Increasing dietary sodium, potassium, or phosphorus levels also elevates water consumption and excreta moisture content in laying hens [32]. A study conducted by Hijikuro [33] found that the amount of water one drinks, the moisture level of their recent bowel movements, and the sodium and potassium levels in their diet are strongly correlated. The research studies conducted by Choi et al. [34] and Kitada et al. [35] provide strong evidence that the renin-angiotensin-aldosterone system plays a vital role in the connection between high salt intake and increased water consumption. This system regulates blood pressure and fluid balance and becomes more active with high salt consumption, leading to a significant increase in water intake. Additionally, some research indicates that high-salt diets may activate specific brain regions responsible for thirst and water intake. Johnson & Thunhorst [36]) discussed the neural network involved in thirst and salt appetite, including osmoreceptors in systemic viscera and central structures and the interplay of multiple facilitatory influences within the brain.

3.4 Growth Performance

In Table 5, we present the effects of salt treatment on the final body weight, mean weight gain, feed conversion ratio (FCR), and protein efficiency ratio (PER) of chickens. The results indicate that the salt treatment did not significantly impact the chickens' final weight, weight gain, or FCR. However, it did affect their PER, with the CD group exhibiting the highest PER, indicating that the chickens in this group could convert the protein in their feed into body weight more efficiently than the other groups. Conversely, the WY30 group showed the lowest PER, indicating that the chickens in this group were less efficient at converting protein into body weight. Anti-nutritional factors include protease inhibitors, lectins, cyanogen, total free phenolics, tannins, phytic acid, saponins, toxic amino acids, antivitamins, and Oxalate, which can reduce protein digestibility and availability [37]. These compounds are likely responsible for the depressed PER of chickens in salt treatment diets for wild yams. However, when wild yams were treated with salt at lower concentrations, the PER value was statistically similar to the value of PER for commercial diets, as reflected in Table 4. This result implies that salt treatments might enhance wild yams' nutritional potential at a minimal concentration. Further investigation is warranted to confirm this finding.

Table 2. Effect of osmosis by salt treatment on the total free phenolics, hydrogen cyanide, and total oxalate content of wild yam tubers

Parameter	Total free phenolics (g/100g)	Hydrogen cyanide (g/100g)	Total Oxalate (g/100g)
WY - Raw	1.72[a]	0.32[a]	1.32[a]
WY - 10	1.24[b]	0.24[ab]	1.16[b]
WY - 20	1.08[bc]	0.20[b]	1.10[b]
WY - 30	0.87[c]	0.16[b]	0.91[c]

Column means of the same letter are not significantly different (P < .05)

Table 3. Effect of salt treatment of wild yam meal at varied concentrations on chicken feed intake

Treatment	Grower Phase		Finisher Phase		Final Feed Intake
	1-2 week	3-4 week	5-6 week	7-8 week	
CD	463.12[a]	547.50[a]	693.04	746.33	2450.00
WY10	417.50[ab]	546.86[a]	644.79	725.21	2334.37
WY20	377.92[ab]	505.42[a]	636.63	806.46	2326.42
WY30	314.35[b]	412.29[b]	650.00	824.37	2201.04

Column means of the same letter are not significantly different (P < .05)
CD – Commercial Diet, WY10 - Wild yam meal at 10%, salt concentration, WY20 - Wild yam meal at 20%, salt concentration, WY30 - Wild yam meal at 30%, salt concentration

Table 4. Water intake of chickens as affected by salt treatment of wild yam meal at varied concentrations

Treatment	Grower Phase		Finisher Phase	
	1-2 week	3-4 week	5-6 week	7-8 week
CD	1.95[b]	2.02[b]	2.06[b]	2.16[b]
WY10	2.07[a]	2.14[a]	2.18[a]	2.27[a]
WY20	2.03[ab]	2.08[b]	2.10[ab]	2.17[b]
WY30	1.96[b]	2.03[b]	2.05[b]	2.14[b]

Column means of the same letter are not significantly different (P < .05)
CD – Commercial Diet, WY10 - Wild Yam Meal at 10%, salt concentration, WY20 - Wild Yam Meal at 20%, salt concentration, WY30 - Wild Yam Meal at 30%, salt concentration

Table 5. Effect of salt treatment of wild yam meal at varied concentrations on initial weight, final weight, mean voluntary feed intake, protein efficiency ratio, body weight gain, feed conversion ratio, and mortality of chicken

Parameters	Treatments			
	CD	**WY10**	**WY20**	**WY30**
Initial Weight (g)	293.83	238.33	246.04	230.63
Final Weight (g)	965.17	843.30	873.50	846.25
PER	5.39[a]	4.64[ab]	4.11[b]	3.68[b]
Body Weight Gain (g)	725.79	615.62	627.45	604.95
FCR (g)	3.39	3.65	3.80	3.82
Mortality	0	0	0	0

Row means of the same letter are not significantly different (P < .05)
CD – Commercial Diet, WY10 - Wild Yam meal at 10%, salt concentration, WY20 - Wild Yam meal at 20%, salt concentration, WY30 - Wild yam meal at 30%, salt concentration

It is worth noting that high salt treatment negatively affects the protein quality of feedstuff. Martínez-Alvarez and Gómez-Guillén [38] found a slight effect on protein composition and functional properties of cod muscle proteins after subsequent dry salting, following brine salting at different pHs. Similarly, Thorarinsdottir et al. [39] reported that injection and brining resulted in less protein aggregation during heavy salting of cod fillets compared to brining only and pickling. Excessive use of salt can induce changes in protein aggregation, physicochemical changes, and oxidative stability, all of which can negatively impact the quality of proteins [38, 39, 40, 41].

In our study, although salt treatment did not significantly affect the final body weight, mean weight gain, FCR, and mortality rate of chickens, the WY30 (T4) chickens had slightly inferior performance in promoting growth. This finding may have some practical significance. This study's slight inferior growth for WY30 treatment might be related to reducing feed and water intake due to high salinity exposure and anti-nutritional factors. Several authors have reported a significant correlation between feed and water intake and chickens' weight and weight gain [42, 43, 44, 45].

3.5 Carcass Traits, Meat Yield, and Organ Weights

Table 6 displays the slaughter weight, semi-eviscerated weight, eviscerated weight, and dressing percentage for each treatment group. The results showed no significant difference in these parameters across treatments, although a slight decrease in values was observed with increasing salt concentration. Furthermore, no significant differences were observed in the weight of different meat parts and organs among the treatment groups, except for gizzard weight (Table 7). These findings suggest that the treatment of salt on wild yam in chicken diets had no significant impact on the overall physiology and anatomy of the chickens. The liver plays a crucial role in the metabolism and detoxification of substances in the body, including the breakdown of dietary components [46].

The higher liver weight observed in the 10% salt concentration group for the wild yam diet may indicate increased metabolic activity and potential stress on the liver due to toxins in the diets. Phytotoxins have been observed to harm liver weight in chickens' diets. An example of research conducted by Liu et al. [47] showed that diets with high phytate levels decreased body weight and glucose concentrations. Additionally, hens fed diets containing wheat contaminated with deoxynivalenol exhibited higher liver lipid levels [48]. Research has unequivocally demonstrated a strong correlation between broilers consuming diets containing aflatoxin B1 and B2 and liver lesions [49]. Unfortunately, there remains limited data regarding how a high-salt diet impacts the weight of a chicken's liver.

When determining a chicken's liver weight, consider factors such as breed and age. Studies show that liver weight can vary greatly, from 35.05 g to 54.1 g. Researchers such as Ahmed [50] and Karthika et al. [51] have reported this. Take these variables into account for an accurate weight. The liver is an essential organ for maintaining a healthy bird, and its weight can be affected by various factors, such as diet [52].

3.6 Meat Quality

Our study examined the impact of salt-treated wild yam on chicken meat quality by analyzing its effect on pH and cooking loss. The findings in Table 8 clearly illustrate that pH levels of breast meat varied between 5.83 to 5.93 at 0 hours post-slaughter and 5.18 to 5.26 at 48 hours post-slaughter. The highest pH value was recorded for WY30, while CD showed the lowest. The cooking loss percentage varied between 39.25% to 58.63% at different post-slaughter time points. WY20 and WY30 had the lowest cooking loss at 0-hour and 24-hour post-slaughter, respectively, while CD consistently had the highest cooking loss at all time points. Despite not significantly impacting the pH or percentage of cooking loss in chicken meat, salt-treated wild yams tended towards higher pH values and lower cooking loss percentages.

The impact of diets containing anti-nutritional factors (ANFs) on the quality and pH of chicken meat is a complex matter that numerous factors can influence. While Brzóska et al. [53] discovered that incorporating an acidifier into broiler chicken feed did not have a significant impact on the meat's pH levels, Aksu et al. [54] found no significant statistical correlation between the concentration of organically complexed minerals in the diet and the pH values of breast fillets.

Table 6. Effect of salt treatment of wild yam meal at varied concentrations on carcass traits of birds in grams

Treatment	Carcass Traits			
	Slaughter Weight (g)	Semi-Eviscerated Weight (g)	Eviscerated Weight (g)	Dressing Percentage (%)
CD	1047.75	808.75	726.25	69.39
WY10	910.00	712.50	633.75	69.82
WY20	930.00	722.50	641.25	68.91
WY30	871.25	662.5	588.75	67.52

CD – Commercial Diet, WY10 - Wild Yam Meal at 10%, salt concentration, WY20 - Wild Yam Meal at 20%, salt concentration, WY30 - Wild yam meal at 30%, salt concentration

Table 7. Relative meat yield and organ weights of native chickens

Treatment	Meat Yield and Organ Weight (%)					
	Breast Meat Weight (%)	Thigh Meat Weight (%)	Abdominal Fat (%)	Liver Weight (%)	Gizzard Weight (%)	Heart Weight (%)
CD	41.92	37.04	0.00205	0.00327	0.00208[b]	0.00085
WY10	40.31	33.72	0.00152	0.00415	0.00319[a]	0.00101
WY20	41.30	35.63	0.00079	0.00408	0.00274[ab]	0.00079
WY30	42.75	34.28	0.00087	0.00324	0.00259[ab]	0.00086

Column means of the same letter are not significantly different (P < .05)
CD – Commercial Diet, WY10 - Wild Yam Meal at 10%, salt concentration, WY20 - Wild yam meal at 20%, salt concentration, WY30 - Wild Yam Meal at 30%, salt concentration

Table 8. Influence of different treatments on cooking loss and meat pH

Meat quality attribute	Treatment	Refrigeration period		
		0-hr	24-hr	48-hr
pH of meat	CD	5.93	5.78	5.25
	WY10	5.88	5.83	5.20
	WY20	5.83	5.78	5.26
	WY30	5.83	5.75	5.18
	CD	54.25	56.02	58.63
Cooking loss, % of initial wt.	WY10	41.50	42.94	44.39
	WY20	39.25	40.87	43.01
	WY30	50.00	52.10	54.29

CD – Commercial Diet, WY10 - Wild Yam Meal at 10%, salt concentration, WY20 - Wild yam meal at 20%, salt concentration, WY30 - Wild Yam Meal at 30%, salt concentration

Conversely, Kyakma et al. [55] observed that adding certain additives, such as cloves and turmeric, substantially reduced the pH of meat from broiler chickens. Meanwhile, Aksu et al. [56] discovered that the pH of carcasses of broilers fed with dietary probiotics decreased with post-mortem aging time. As a result, the effect of ANFs in diets on the pH of chicken meat may be influenced by the specific additives used and other variables such as post-mortem aging time.

Remembering excessive salt intake may lead to salt toxicity, damaging the body and even causing death (Simiyoon et al. [57]. Besides, too much salt can disrupt meat's pH balance, decrease blood volume, and raise blood osmolality. High salt concentration in meat can affect muscle fiber protein structure and decrease water retention during cooking, resulting in more cooking loss. Typically, the pH of meat and cooking loss are positively related [58, 59].

4. CONCLUSION

This study demonstrated that salt-assisted osmosis can effectively eliminate anti-nutritional factors including phenolics, hydrogen cyanide, and oxalates from wild yam tubers in a concentration-dependent manner, with 30% NaCl solution decreasing these toxins up to 50%. The osmosis process selectively draws out water-soluble toxins through diffusion while retaining beneficial nutrients like protein and fiber. Incorporating salt-treated wild yam meal in supplementary chicken feed at a 30% inclusion level showed comparable body weight gain, feed conversion, and carcass characteristics to a control commercial diet, although higher salt levels reduced feed intake and protein digestibility efficiency. This indicates the potential suitability of osmotically processed wild tubers as an alternative feed ingredient after optimal salt treatment protocols are standardized.

In summary, this green detoxification approach can promote better utilization of climate-resilient under-exploited crops to nourish livestock and enhance circular local food systems adapted for nutrition security amidst climate challenges. Further research should investigate the sensory attributes of salt-treated tubers and their performance in other livestock species at both smallholder and commercial scales.

ETHICAL APPROVAL

The study was conducted in accordance with ethical guidelines of Animal Welfare Act RA 8485 of the Republic of the Philippines and approved by the institutional animal ethics committee of Surigao del Norte State University, Philippines.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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