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Assessing the nutritional composition of sweet corn (zea mays l. var. saccharata) stover and kernel corn (zea mays l. var. indentata) stover for ruminant feed

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ABSTRACT

Corn stover, which includes stalks, leaves, and husks left in the field after harvest, holds promise as a feed source for ruminant livestock due to its nutritional value. However, a lack of research on its nutritional composition has led to wasteful practices like open burning and disposal. Therefore, this study aims to determine and compare the nutritional value of corn stover between sweet and kernel corn. The samples of corn stover were collected at Universiti Sultan Zainal Abidin Farm. All samples were subjected to the cleaning, chopping, drying, and grinding processes before undergoing nutritional analysis using proximate analysis. The proximate analysis was measured based on the percentage of crude protein, ash, crude fibre, moisture, and fat. The results indicate that sweet corn stover exhibits the highest nutritional value ($p < 0.05$) in terms of ash, crude protein, and fat, with percentages of 5.44%, 19.04%, and 3.86%, respectively, particularly in its leaves. Additionally, the stalks of sweet corn stover contain the highest percentages of moisture (4.89%) and crude fiber (27.05%). This study found that sweet corn stover is more suitable for ruminant feed because it contains the highest levels of essential nutrients like crude protein, fat, and ash.

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Contribution/ Originality: This study focused on a comprehensive assessment of the nutritional composition of both sweet corn and kernel corn stover for ruminant feed. This approach allows for a direct comparison of the suitability of these two corn varieties as feed sources, contributing valuable insights into potential feed options for ruminant animals.

1. INTRODUCTION

Ruminant production plays a pivotal role in global livestock farming, especially in developing countries [1]. In Malaysia, the production of ruminants, especially cows, holds a prominent position within the agricultural sector, bolstered by the increasing economic value of the beef and milk industry, which is partly reflected in consumption prices [2]. However, despite their significance, ruminant production faces notable challenges, with inadequate feed resources being a primary concern [1, 3]. This shortage of high-quality feed resources also acts as a limiting factor for the expansion of Malaysia's cow industry, leading to elevated prices and potential impacts on end products such as higher costs for milk and meat [4].

As an alternative approach to animal feed, corn stover can serve as valuable fodder. Corn, hailed as the queen of grains, is a widely renowned cereal plant and ranks as the third-largest global crop, trailing only wheat and rice

[3]. In Malaysia, the trajectory of corn production has been remarkable, surging from a mere five thousand tons in 1971 to 60 thousand tons in 2020, with an average annual growth rate of 14.03% [5]. Various types of corn are cultivated worldwide, such as dent or grain corn, flint corn, floury corn, sweet corn, baby corn, and popcorn. These diverse corn types find application across various domains such as culinary consumption, animal feed, morning cereals, corn starch sweeteners, feed additives, cooking oil, and industrial products like ethanol and polylactic acid.

In Malaysia, however, the prevalent varieties of corn under cultivation primarily consist of grain corn and sweet corn [6]. Interestingly, a noteworthy portion of the grain corn consumed in Malaysia is imported from nations such as Argentina, Brazil, and others. In 2017, the country expended an estimated 3 billion Ringgit Malaysia (RM) on importing corn kernels [7]. Kernel corn lacks the distinctive sweetness and juiciness typically associated with sweet corn due to its elevated starch content and comparatively lowers sugar content. While a significant portion of kernel corn is cultivated for animal feed, other variants find their way into products like chips and cornmeal, diversifying its applications. Conversely, sweet corn has garnered substantial global attention due to its delectable flavor and nutritional richness, emerging as a prized crop in numerous countries [8]. Being primarily intended for human consumption, sweet corn boasts a higher water and sugar content while maintaining lower starch levels [9].

Recent years have witnessed an increase in animal feed ingredient prices due to new price levels in the global agricultural market. The COVID-19 pandemic also disrupted the global supply network, including the supply chain for imported animal feed. Additionally, significant investment funds around the world started trading agricultural items, leading to stockpiling and driving up agricultural product prices. This escalation in feed prices poses challenges for farmers, requiring attention to address the issue [10]. Despite being commonly used for human food, corn residues can also serve as valuable feed for animals, particularly ruminants, due to their excellent nutritional value, which enhances growth rates.

Historically, the conventional practice among corn farmers has involved the burning of corn stover as a means of preparing the land for subsequent harvests. However, this approach has been found to have adverse environmental consequences, including the release of greenhouse gases, the generation of air pollutants, and the degradation of soil quality. Gaseous pollutants like CO_2, CH_4, CO, N_2O, and particulate matter particles emitted from open burning can harm human health and cause various health issues [11]. To tackle the increasing animal feed issue and mitigate environmental problems caused by burning corn residues, corn stover can be effectively used as animal feed. This agricultural waste product offers an affordable and nutrient-rich option for livestock animals and reduces dependency on conventional animal feed. The corn stover can be utilized in its original form or processed into silage [12]. By employing corn stover as animal feed, we can take a step towards safeguarding the environment by minimizing air pollution [13]. Despite its potential, there is a lack of comprehensive studies on the nutritional composition of corn stover, leading to extensive field waste, open burning, and disposal issues. Therefore, the objectives of this study are to determine and compare the nutritional value of corn stover between sweet and kernel corn as potential for ruminant feed.

2.MATERIALS AND METHODS

2.1. Sample Collection

Samples of sweet corn and kernel corn stover were gathered at the Universiti Sultan Zainal Abidin (UniSZA) KampusBesut Farm, located at coordinates 5°75'55" N, 102°63'19" E. The collected samples were divided into three components (stalks, leaves, and husks), placed in separate plastic bags, and transported to the Plant Physiological Laboratory at UniSZA'sBesut Campus for subsequent analysis.

2.2. Sample Preparations

The sample of corn stover's leaves, stalks, and husks underwent a thorough rinsing with running water to remove any dirt or soil. These chopped samples were spread on trays and dried in an oven at 65°C for 72 hours [14]. Subsequently, the samples were finely ground using a Waring Commercial Laboratory Blender (Model 8010S/G, made in the United States) to obtain a homogeneous powder for further analysis. The resulting powder was stored in zip-lock plastic bags, labeled, and kept under cool, dry, room-temperature conditions to maintain freshness.

2.3. Proximate Composition Analysis

Proximate analysis was performed to determine the quantitative measurement of moisture content, fat, crude fibres, ash, protein, and nitrogen-free extract of the sweet and kernel corn stover. All samples were analysed in triplicate according to the standard methods of the Official Association of Official Analytical Chemists (AOAC) [14]. The detailed procedures for each parameter were as follows:

2.3.1. Moisture

Moisture represents the water content in the feed, while dry matter refers to the material that remains once water is eliminated [14]. In this study, fresh samples were utilized, and the analysis employed the oven-drying method. Initially, a dry crucible with a lid was heated to 105°C for 4 hours (w1). Then, 3 grams of homogenized samples were weighed on an analytical scale and placed in the crucible (w2). Subsequently, the crucible with the sample was heated at 105°C for 6 hours, cooled in a desiccator, weighed (w3), and removed after reaching room temperature. The formula for calculating moisture and dry matter is as follows:

$$\%\ Moisture\ =\ (w2\ /w3)\ /(w3\ -\ w1)\quad(1)$$

Where,

$w1 = Weightofemptycrucible\ \ (g)$

$w2 = Weightofcr(g)\ + weightofwetsample\ \ (g)$

$w3 = Weightofcrucible\ \ (g) + weightofdrysample\ \ (g)$

2.3.2. Ash

Ash represents the inorganic residue remaining after the combustion of water and organic matter [14]. To determine the ash content, the following steps were taken: Initially, crucibles were dried with lids in an oven at 105°C for four hours. Subsequently, the cooled crucibles were weighed at room temperature (w1). Samples were then weighed (w2) and placed into the crucibles. Samples with high moisture content were dried in an oven for a day. These dried samples were subjected to a muffle furnace, heated to 550°C overnight, and then cooled in a desiccator before being weighed at room temperature (w3). The following formula was used to calculate the ash percentage:

$$\%\ Ash\ =\ (w3\ -\ w1)\ /w2\ \times\ 100\quad(2)$$

Where,

$w1 = Weightofemptycrucible\ \ (g)$

$w2 = Weight\ (g)$

$w3 = Weightofcrucible\ \ (g) + Ash\ (g)$

2.3.3. Crude Protein

Crude protein analysis was conducted using the Kjeldahl method, involving three key steps: digestion, dilution, and titration. Proteins and other organic compounds were broken down by sulfuric acid (H2SO4) with the help of catalysts. This turned organic nitrogen into ammonium sulphate. Specifically, 1 g of the sample was placed in a digestion tube, followed by the addition of Kjeltabs Cu 3.5 catalyst. Subsequently, concentrated H2SO4 was added to the tube and gently mixed with the sample. The digestion tubes were loaded onto a rack with an exhaust system, which was then attached to a digester block. The temperature was set to 420°C, and samples were digested for 60-90 minutes until they became clear with a green or blue solution.

In the distillation step, the digested samples within the digestion tube were transferred to the distillation unit. A conical flask was prepared with a receiver solution containing 25 ml of 2% boric acid and 10 drops of indicator solution, and it was placed in the distillation unit. Subsequently, an automated process added 70 ml of distilled water and 50 ml of 32% sodium hydroxide (NaOH) to the digestion tube, taking approximately 4 minutes. The distillate in the flask changed to a green color due to the presence of ammonia, an alkali.

In the titration phase, the distilled sample was titrated using standard 0.1 N hydrochloric acid (HCl) until it changed to a pink or red hue. The volume of HCl used was recorded. The protein percentage was then calculated using the following formula:

$$\%\ Nitorgen\ = [\ A\ X\ (T - B)\ X\ 14.007\ X\ 100\ weight\ of\ sample\ x\ 100\ ]\ \ (3)$$

and,

$$\%\ Crude\ protein\ = \%\ Nitrogen\ X\ F \qquad (4)$$

Where,

$T = Volumeofacidforsample\ \ (ml)$

$B = Volumeofacidforblank\ \ (ml)$

$A = NormalityofHCL$

$F = Proteinfactor,\ 6.25$

2.3.4. Fat

To begin, extraction cups were initially dried in an oven at 105°C for six hours and subsequently allowed to cool in a desiccator one day before the experiment. Afterward, the pre-dried extraction cups were secured with a holder for weighing (w2). Next, three grams of samples were weighed (w1), wrapped in filter paper, and then inserted into the extraction thimble. Following this, 150 ml of petroleum ether was measured using a volumetric cylinder and carefully poured into the extraction cup. Next, the extraction thimble was inserted into the thimble holder and placed within the extraction cup. This extraction cup contained both the sample and 150 ml of petroleum ether. The setup was then positioned in the Automated Soxhlet Fat Extractor system (Model Gerhardt Analytical Soxtherm 6, made in Germany), and the extraction process lasted approximately 2 hours.Upon completion of the extraction, the cups with extracted petroleum were transferred to an oven set at 105°C for 2 hours. Subsequently, the extraction cups were moved to a desiccator for cooling. Finally, the extracted cups were weighed using an analytical scale (w3). The fat percentage was determined using the following formula:

$$\%\ Lipid\ = \frac{(w3\ -\ w2)}{w1} \times\ 100 \qquad (5)$$

Where,

$w1 = Weightofsample\ \ (g)$

$w2 = Weightofextractioncup\ \ (g)$

$w3 = Weightofextractioncup\ \ + fat\ (g)$

2.3.5. Crude Fibre

Crude fiber (CF) quantifies the indigestible components within the feed, including lignin, chitin, pentosan, and cellulose. Initially, empty fiber bags were weighed (w1) using an analytical scale. Subsequently, 1 g of the sample was placed into the fiber bag and weighed (w2) using the same analytical scale. Glass spacers were then inserted into the fiber bags, and these bags were arranged in a carousel. For samples with fat content exceeding 10%, defatting was performed by immersing the carousel three times in 100 ml of 40/60 (boiling range) petroleum ether. The axis carousel was integrated into the structure and afterwards enclosed behind a transparent glass enclosure. The vessel was placed onto the heated surface prior to the activation of apparatus.

After the analysis, the fiber bags were removed from the carousel and placed into crucibles. Both the fiber bags and crucibles were dried for 4 hours at 105°C and subsequently cooled in a desiccator for 30 minutes. The crucible and the dried fiber bag were then weighed using the analytical scale (w3). The crucible containing the fiber bag was placed in a furnace at 550°C and incinerated for four hours. Following incineration, the crucibles containing the ash were cooled in a desiccator to room temperature and weighed using the analytical scale (w4). The weight of the empty crucible was determined (w6). The ash and the crucible of the empty fiber bag were weighed (w7). The blank value of the empty fiber bag (w5) was calculated by subtracting the value of the ash and crucible of the empty fiber bag (w7) from the weight of the empty crucible (w6). The percentage of crude fiber was calculated using the following formula:

$$\%\,Crudefibre = [(w3 - w1) - (w4 - w5)]\,w2 \times 100 \quad (6)$$

$$Blank\ value\ (w5) = w7 - w6$$

Where,

$w1 = Weightoffiberbag\ \ (g)$

$w2 = Weightofsample\ \ (g)$

$w3 = Weightofcrucible\ \ (g) + fiberbagafterdig(g)$

$w4 = Weightofcrucible\ + ash\ (g)$

$w5 = Weightofblankvalueoftheemptyfibre\ \ (g)$

$w6 = Weightofcrucible\ \ (g)$

$w7 = Weightofcrucible\ + ashoftheemptyfibre\ \ (g)$

2.3.6. Nitrogen-Free Extract (NFE)

Nitrogen-free extract (NFE) was calculated as the difference between all the nutrient values determined in the proximate analysis. The NFE fraction includes a number of unknown components that were not looked at in the proximate analysis. It represents the feed's soluble carbohydrates, such as sugar and starch. This fraction can also include the solubilization of hemicellulose and lignin. Equation 7 represents the calculation of NFE:

$$\%\,NFE = \%\,DM - (\%\,Fat + \%\,CP + \%\,ash + \%CF) \quad (7)$$

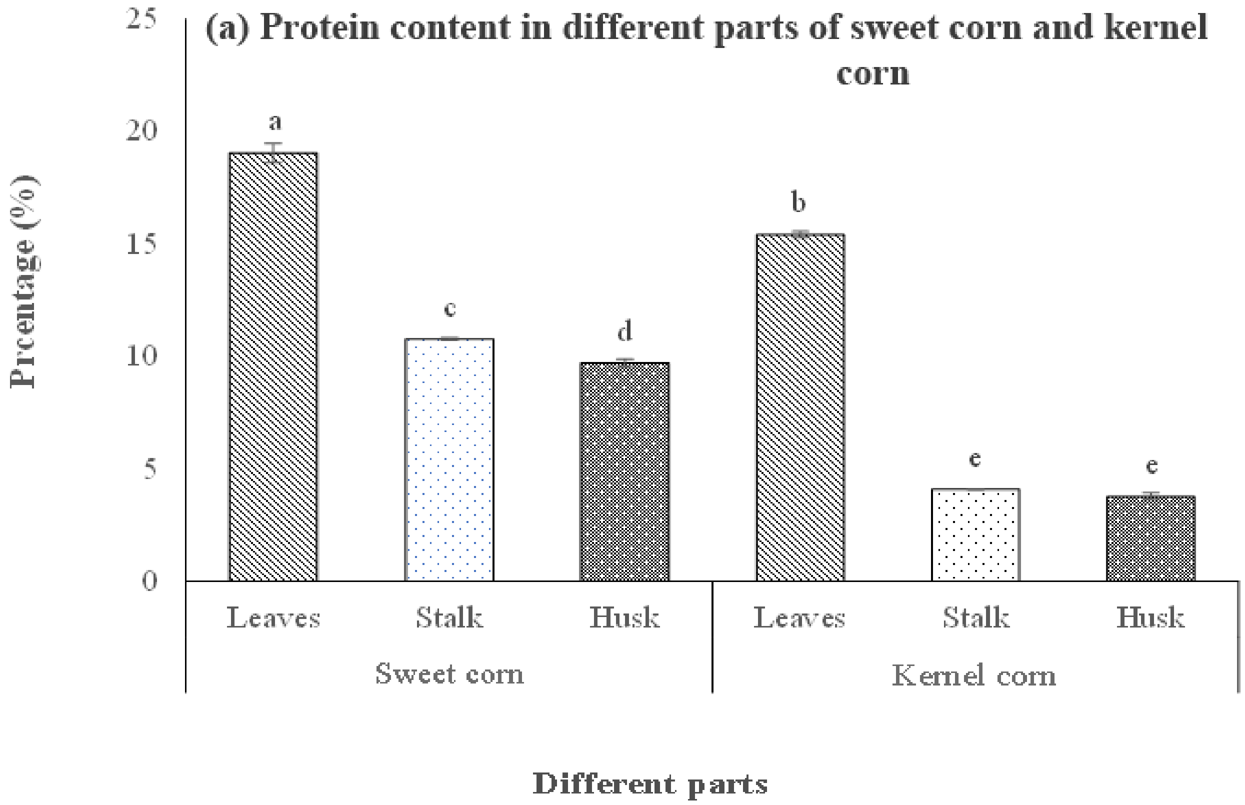
2.4. Data Analysis

We used Minitab version 17.0 and Microsoft Excel version 2013 to do a one-way ANOVA analysis on the data to see if the mean values changed between the different parts of the sweet corn residues. A p-value (p 0.05) served as the indicator of significance.

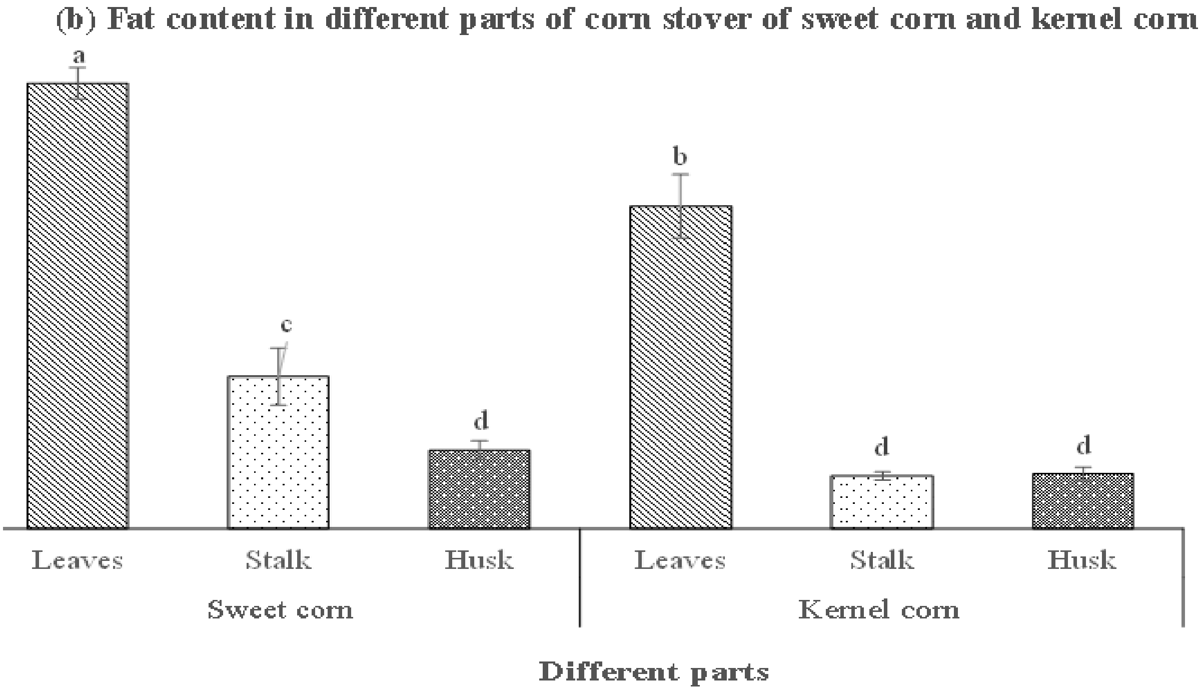
3. RESULTS AND DISCUSSION

3.1. Proximate Analysis

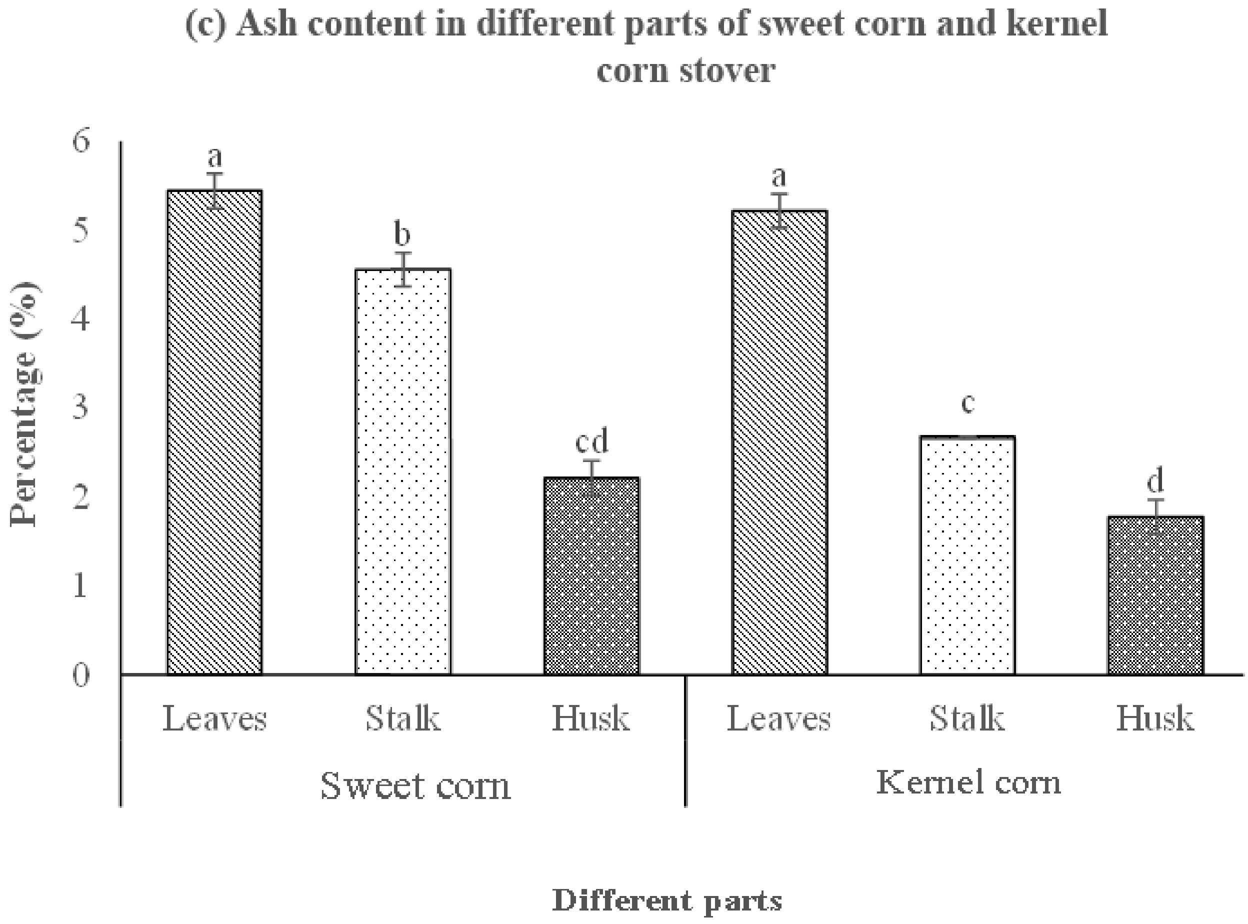
The results of proximate analyses of sweet and kernel corn stovers at three different parts, which are leaf, stalk, and husk, were shown in Figures1a, 1b, 1c, 1d, 1e, and 1f. Among these analyses, the leaves of sweet corn exhibited the highest proportions of crude protein, ash, and fat, while the kernel corn stalk claimed the highest percentage in terms of fiber content.



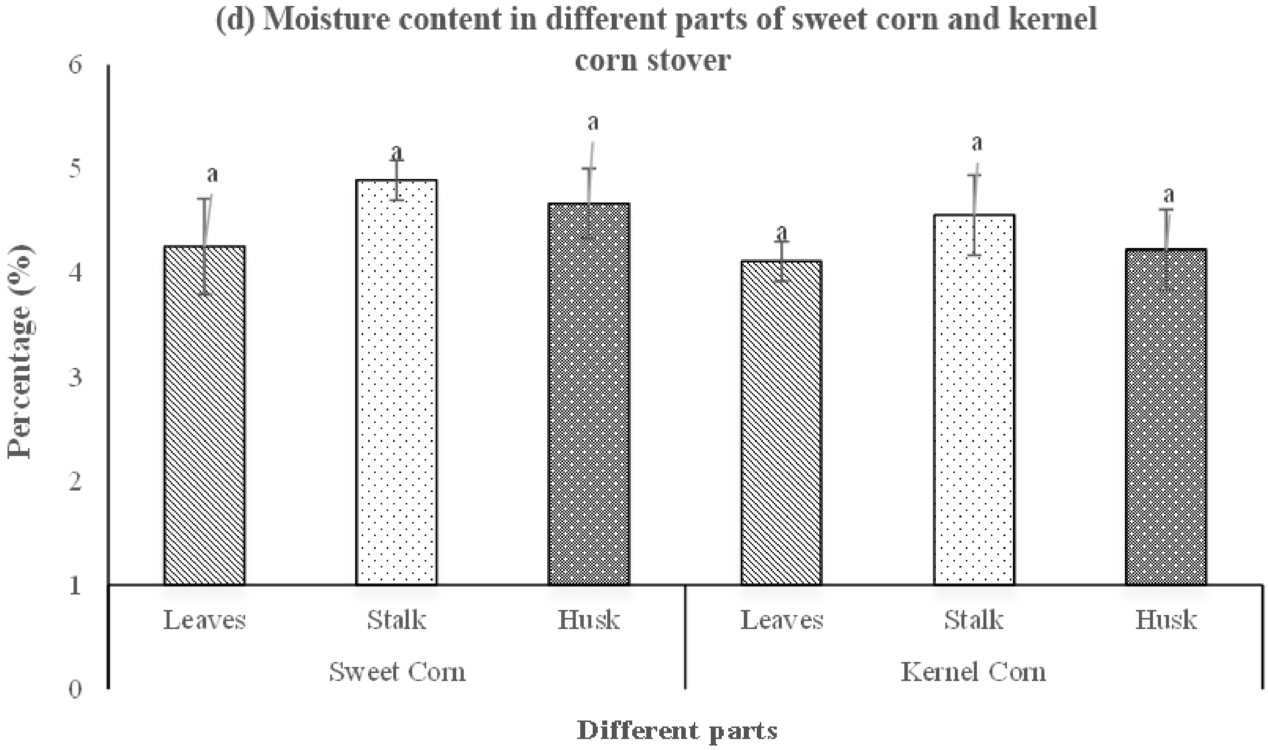
Note: The values with different superscript letters (a,b,c,d,e) in a graph indicate a significantly different ($p<0.05$) among groups.



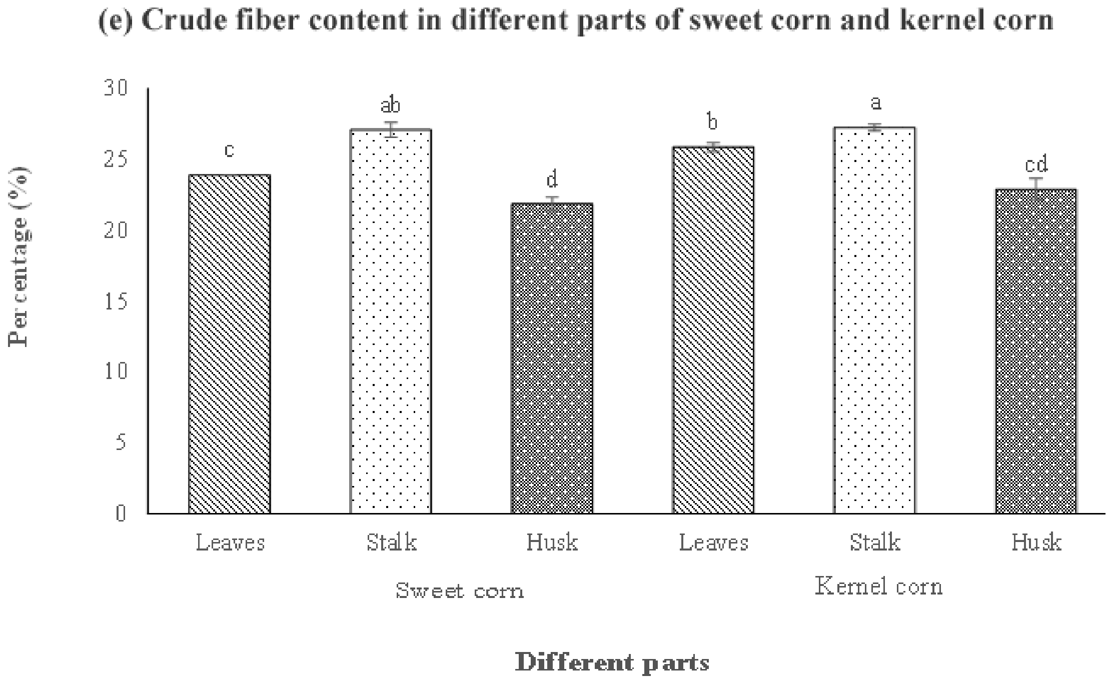
Note: The values with different superscript letters (a,b,c,d,) in a graph indicate a significantly different ($p<0.05$) among groups.



Note: The values with different superscript letters (a,b,c,d,) in a graph indicate a significantly different (*p<0.05*) among groups.



Note: The values with same superscript letters in a graph indicate a significantly different (*p<0.05*) among groups.



Note: The values with different superscript letters (a,b,c,d,) in a graph indicate a significantly different ($p<0.05$) among groups.

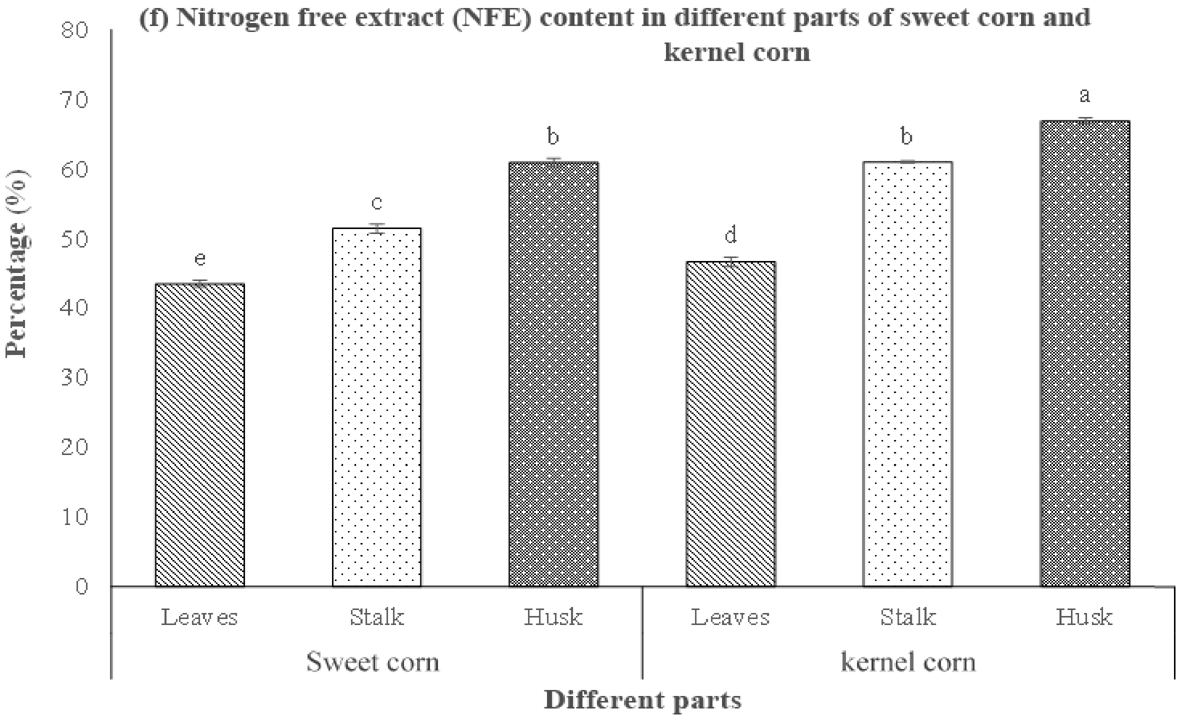


Figure 1. Nutritional composition in different parts of the sweet corn and kernel corn stover.

Note: The values with different superscript letters (a,b,c,d,e) in a graph indicate a significantly different ($p<0.05$) among groups.

3.1.1. *Crude Protein Content*

Figure 1a shows the protein content in the different parts of sweet corn and kernel corn. The sweet corn leaves exhibited the highest content of crude protein, measuring 19.04%, whereas the kernel corn leaves contained a comparatively lower content of crude protein, at 15.41%. Statistical analysis revealed significant differences in the mean crude protein content for both species ($p<0.05$). Crude protein stands as a pivotal constituent in the ruminant diet, encompassing both authentic crude protein and non-crude protein components [14]. The stalk and husk of both sweet corn and kernel corn stover are the next-highest source of crude protein, as shown in Figure 1a.

Notably, the crude protein content in the leaves of both corn stover types consists of 19.04% and 15.41%, respectively, whereas the stalk records 10.47% and 4.09%, and the husk stands at 9.70% and 3.77%. These results display a significant variance at $p<0.05$. These findings parallel those of a prior study by Kamaruddin and Yasin [15], wherein leaves were identified with the highest crude protein content, marked at 16.86%. This observation resonates with the findings of Ayaşan, et al. [16], who indicate that leaves have a higher proportion of crude protein, notably 12.41% in kernel corn leaves. The heightened crude protein content within the leaves is largely attributed to photosynthesis and nutritional reserves. Furthermore, according to Ondarza [17], large ruminants necessitate a minimum of 16% crude protein to optimize the growth and activity of ruminal bacteria. Correspondingly, Fuller [18] notes that leaves emerge as a more appetizing and digestible component for ruminants.

3.1.2. Fat Content

Figure 1b illustrates the variation in fat content among the distinct parts of sweet corn and kernel corn. Shifting the focus to fat content, the sweet corn leaves showcased the highest proportion, measuring at 3.86%, whereas the kernel corn leaves held a slightly lower content of 2.79%. The stalk consists of the second highest fat content in both types of corn stover, which are 1.32% and 0.47%, followed by the husk, which consists of 0.68% and 0.46% of fat content for sweet corn and kernel corn, respectively. An analysis of fat content similarly unveiled a significant difference ($p<0.05$) in the mean values for both species. Fat is an organic molecule, according to Jones, et al. [19], and it dissolves in organic solvents but not in water. The ether extract is another term for it, and it contains triglycerides, which are usually required for animal feeding.

The results of this study correspond with those by Ayaşan, et al. [16] and Kamaruddin and Yasin [15], which stated that the fat content in the leaves has the highest, which is 1.03% in kernel corn leaf and 2.20% in sweet corn leaf, respectively. It could be attributed to a high fat content that is higher in the leaves, which is known as glycerol glycol lipids. The glycerol glycol lipids are largely present in chloroplast membranes, which are concentrated, particularly in the parenchyma cells of the leaf mesophyll Esmail [20]. Kowalik, et al. [21] stated that the corn stalk cut between 15 and 55 cm and above 55 cm had fat contents of 0.46% and 0.76%, respectively. In the present study, we used whole stalk corn, from the upper to the bottom which results in 1.32% for sweet corn stalks and 0.47% for kernel corn stalks. According to Esmail [20], ruminants should have between 2% and 3% of their body weight in fat. In order to feed ruminants properly and prevent off-feed issues, the fat content is essential at low levels [19]. However, Anitha, et al. [22] also noted that the amount of fat cannot exceed 7% of diet dry matter if it is fed to ruminants due to its propensity to generate significant side effects such as metabolic issues that might harm the health of the rumen.

3.1.3. Ash Content

Figure 1c depicts the distribution of ash content within the different parts of sweet corn and kernel corn. The term "ash component" of feed pertains to its primarily mineral-based, inorganic composition [22]. As indicated by the results in Figure 1c, the sweet corn stover's leaves exhibited the highest ash percentage at 5.44%, followed by the stalk at 4.56% and the husk at 2.22%, respectively. This variation showed a significant distinction ($p<0.05$). In comparison, for kernel corn, the highest ash content was observed in the leaves at 5.22%, followed by the stalk at 2.67%, and the husk at 1.78%.

To contrast both species, the sweet corn leaves boasted the highest ash content at 5.44%, while the kernel corn leaves contained only 5.22%. Notably, no significant difference ($p>0.05$) in ash content was observed between the two types of corn stovers. Aligning with earlier research, Amodu, et al. [23] reported ash content in the range of 4.9%-5.1% for corn stovers. The study by Ayaşan, et al. [16] revealed an ash content of 5.78% in kernel corn leaves, while Kamaruddin and Yasin [15] found the ash content in sweet corn leaves to be 4.20%. It's important to note that mineral content is subject to variation based on plant variety Ullah, et al. [24]. Anitha, et al. [22] elucidated that crucial nutrients influencing bone strength, blood clotting, enzyme activity, and muscle contraction hinge on minerals, in which ruminants must invest in precise quantities. Consequently, minerals hold significance in animal nutrition and are particularly pertinent in corn [25, 26]. Specifically, the ash content was recorded at 5.44% in the sweet corn leaf and 5.22% in the kernel corn leaf.

3.1.4. Moisture Content

Figure 1d shows the moisture content of different parts of the sweet and kernel corn stover. Conversely, concerning moisture content, the highest level was detected in the sweet corn stalk, registering at 4.89%, whereas the kernel corn stalk exhibited a slightly lower moisture content of 4.55%. It's worth noting that no significant differences ($p>0.05$) in mean values for both species were found in terms of moisture content across these parts.The highest percentage of moisture, based on Figure 1d, was in the sweet corn in the stalk, husk, and leaves, with 4.89%, 4.67%, and 4.25%, while in the kernel corn, it was 4.55%, 4.22%, and 4.11%, respectively. This result corresponds to the previous study by Guo, et al. [27], which stated that the moisture content is in the range of 3.03%-7.41% in the corn stover. To compare the moisture content based on this study, it shows that sweet corn stalk has the highest with 4.89%, whereas kernel corn stalk has only 4.55%.

In a previous study by Kamaruddin and Yasin [15], it was reported that the moisture content in sweet corn stalks was 71.45%. For kernel corn stalks, studies by Ayaşan, et al. [16] and Zawawi, et al. [28] found moisture contents of 7.14% and 7.3%, respectively. Notably, moisture content exhibited significant variation among different parts of the corn plant Ayaşan, et al. [16]. Ayaşan, et al. [16] emphasized that moisture content can fluctuate during sample preparation and scanning due to external factors like temperature and humidity, which can affect moisture determination accuracy. Esmail [29] pointed out that water consumption for ruminants increases when they are fed diets with lower moisture percentages, such as hay or straw, containing only about 10% moisture, compared to diets primarily based on silage, which contains around 70% moisture. Consequently, farmers must be mindful of ruminants' daily water requirements. According to Esmail [29], cattle require approximately 30 kg of water daily, while small ruminants need around 4 kg. These requirements can vary based on factors like body size, metabolic activity, and production levels.

3.1.5. Crude Fiber Content

Figure 1e illustrates the distribution of crude fiber content within distinct segments of both sweet corn and kernel corn plants. In terms of crude fiber percentage, the stalks of kernel corn exhibit the highest content at 27.23%, surpassing the content in sweet corn stalks, which stands at 27.05%. Nevertheless, statistical analysis reveals no significant disparity ($p>0.05$) in the mean crude fiber values between the two species within this context. The stalk component of sweet corn has the highest crude fiber content (27.05%), then the leaves (23.88%), and the husk at (21.82%). Notably, the observed variations here are statistically significant at a significance level of $p<0.05$.

Meanwhile, in the kernel corn composition, the stalk also emerges as the primary contributor to crude fiber content, with a recorded value of 27.23%. This is followed by the leaves at 25.83% and the husk at 22.87%. The outcomes of this analysis align with the findings of Kamaruddin and Yasin [15], who identified the stalk as containing the highest proportion of crude fiber at 32.26%. The stalk's prominence can be attributed to its elevated hemicellulose content, a pivotal natural fiber component within the plant structure. As affirmed by Li, et al. [30], corn stalks harbor an abundance of structural and conducting tissues, whereas the leaves are chiefly composed of thinly-walled mesophyll cells. Functionally, the stalk serves a supportive role, contributing to defense mechanisms against pathogens, pests, and cold stress. Notably, the stalk's relatively heightened lignin concentration aids in facilitating the ruminant's rumination process, as suggested by Li, et al. [30]. This phenomenon is reinforced by Li, et al. [30] assertion that the elevated fiber concentration obstructs ruminal hydrolytic enzymes' access to cellulose and hemicellulose substrates.

3.1.6. Nitrogen-Free Extract (NFE) Content

Figure 1f presents an analysis of the compositional variations among different segments of sweet corn and kernel corn. Notably, in terms of Nitrogen-Free Extract (NFE) percentage, the husk of kernel corn exhibits the highest value at 66.89%, while the husk of sweet corn lags behind at 60.92%. Statistical analysis of NFE content underscores the presence of a significant distinction in mean values ($p<0.05$) between the two categories. Anitha, et al. [22] elucidate that Nitrogen-Free Extract (NFE) primarily encompasses readily digestible carbohydrates. The proportions of crude protein, crude fiber, total ash, and fat within the samples exert an influence on the NFE percentage. Figure 1f substantiates these assertions, revealing that the husk of sweet corn records the highest Nitrogen-Free Extract (NFE) proportion at 60.92%, followed by the stalk at 51.42% and the husk at 43.55%.

Similar trends are evident in the case of kernel corn, with the husk recording the highest NFE content at 66.89%, the stalk coming in second at 60.99%, and the leaves coming in third at 46.63%. The observed distinctions are statistically significant at a level of $p<0.05$. A comparative analysis between the two corn types indicates that kernel corn husks dominate with a Nitrogen-Free Extract (NFE) content of 66.89%, whereas the corresponding value for sweet corn husks reaches 60.92%. A prior investigation by Kamaruddin and Yasin [15] aligns with these findings, showcasing the highest NFE content within the husks of sweet corn, at 71.65%. This observation finds support in the significant presence of sugars and carbohydrates within the husk composition [31]. Notably, the Nitrogen-Free Extract (NFE) content has the potential to fuel various biological processes within ruminants.

4. CONCLUSION

In conclusion, this investigation underscores the discernible impact of distinct corn plant variants on the nutritional profile of both sweet and kernel corn stover. The nutritional composition of these stover types was ascertained via proximate analysis, encompassing the quantification of ash, moisture, protein, fiber, fat, and Nitrogen-Free Extract (NFE) content within each component of corn stover, namely the leaves, stalk, and husk. The outcomes of the proximate analysis unveiled noteworthy statistical disparities ($p<0.05$) in the means for both sweet and kernel corn stover. This study illuminates that sweet corn stover possesses characteristics rendering it more amenable as ruminant fodder, owing to its enriched nutritive content in terms of essential components like crude protein, ash, moisture, and fat, which hold significance within the ruminant dietary context, in comparison to kernel corn stover. In view of future research, we recommend meticulous determination of the precise corn plant age before embarking on the analysis, ensuring heightened result accuracy. Furthermore, we propose segmenting the corn stalk into three distinct portions–upper, middle, and lower–during analysis. This partitioning strategy is grounded in the understanding that each segment harbors unique nutritional compositions, warranting a comprehensive evaluation of the corn plant's nutritional profile.

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