Jurnal Pijar MIPA
https://jurnalfkip.unram.ac.id/index.php/JPM

ISSN 1907-1744 (Print)
ISSN 2460-1500 (Online)

Nutrient Content of Corn Straw (Crude Fibre, Crude Fat and TDN) Caused by Different Doses of Urea

Azhary Noersidiq*, Oscar Yanuarianto, Fahrullah Fahrullah, Vebera Maslami, Hasma

Department of Animal Science, Faculty of Animal Science, University of Mataram, Mataram, Indonesia
*E-mail: az.noersidiq@unram.ac.id

Received: March 13, 2024. Accepted: June 4, 2024. Published: July 27, 2024

Abstract: This research aims to evaluate ammoniated corn straw's nutritional content and determine the best urea dose. Corn straw is one of the alternative feed sources from waste in the livestock industry. They contain crude 6.38%protein, 30.19%crude fibre, 2.81%crude fat, 51.69% EMWN, 8.94%ash, 53.12%TDN, 22.5% hemicellulose, 10.6% lignin, and 32.9% cellulose. However, the nutritional quality of corn straw can be affected by various factors, such as the high lignin content. It can bind to cellulose and hemicellulose, reducing digestibility and utilization as animal feed, so it needs to be processed first, one of which is ammoniation technology using urea. This research used 500 grams of corn straw and urea for the ammoniation process based on dry matter (DM) of corn straw for urea doses. The research designed by a complete randomized design (CRD) consisting of 4 treatments and 4 replications, namely T1= only corn straw (control), T2= corn straw with 2% urea, T3= corn straw with 4% urea and T4= corn straw with 6% urea. The variables measured were crude fiber, crude fat,, and TDN. The results showed that urea used in the ammoniation process of corn straw showed a significant effect ($P<0.05$) on increasing the content of crude fiber, crude fat,, and TDN. Urea can stretch the bonds between lignocellulose, It was concluded that the best urea dose is at 6%, with 25.91% crude fibre, 2.65% crude fat, and 60.91% TDN respectively.

Keywords: Corn Straw; Crude Fat; Crude Fiber; TDN; Urea Doses.

Introduction

Corn straw is one of the alternative feed sources from waste in the livestock industry. This is based on the abundant availability and relatively low price of this agricultural waste, which is often not fully utilized. Furthermore, using maize straw as animal feed also provides environmental sustainability benefits by assisting in agricultural waste management and reducing negative environmental impacts. Although corn straw has a low nutrient content, proper processing, such as ammoniation and fermentation, can increase its nutritional value. The use of corn straw can also help farmers save costs due to its affordable price and can increase livestock productivity when combined with other nutrient-rich feeds.

Corn straw contains crude protein 6.38%, crude fibre 30.19%, crude fat 2.81%, EMWN 51.69%, ash 8.94%, and TDN 53.12% [1], where TDN reflects the level of digestibility of feed energy sources for ruminants. Corn straw contains 22.5% hemicellulose, 10.6% lignin, and 32.9% cellulose [2]. However, the nutritional quality of corn straw can be affected by various factors such as the high lignin content so it needs to be processed first, one of which is ammoniation technology using urea. Ammoniation is a technology that improves feed quality and reduces lignin levels using urea [3]. Ammonia produced from the ammoniation process can stretch the bonds of lignin with cellulose and hemicellulose so that rumen microbes can easily penetrate and increase digestibility [4]. In addition, ammoniation can also increase the protein content of the feed because urea is a source of NPN (non-protein nitrogen) where there is an increase in crude protein of corn straw from 13.53% to 23.81% or an increase of 76% [5]. In this process, different doses of urea can affect the chemical composition of corn straw, especially the content of crude fibre, crude fat, and TDN (Total Digestible Nutrient).

Crude fibre content is an essential indicator in evaluating feed quality and digestibility. Proximate analysis is a chemical test to determine the nutrient content of a feed or feed material. It is divided into six nutrient fractions: water content, crude protein, crude fat, crude fibre, ash, and extract material without nitrogen (EMWN) [6]. Increasing the dose of urea in ammoniated corn straw is believed to affect the degradability of crude fibre, which in turn can affect feed digestibility. In addition, crude fat is also a significant component in assessing feed nutritive value. Increasing the urea dosage may potentially affect corn straw's crude fat content after ammoniation. TDN (Total Digestible Nutrient) is another important parameter that describes feed quality. TDN measures the amount of energy that can be absorbed from livestock feed. Changes in urea dosage in ammoniated corn straw can impact TDN values, affecting feed efficiency and livestock growth. This is because urea is a source of NPN used as a source of protein in the fermentative digestion process, so the use of urea as a source of NPN is balanced, and has more benefits if added to feeds with high soluble carbohydrate content [7].

Therefore, this research aimed to evaluate the nutritional content of ammoniated corn straw and determine the best urea dose to increase the digestibility and utilization of corn straw as an alternative feed for ruminants. With a better understanding of the effects of

How to Cite:
Noersidiq, A., Yanuarianto, O., Fahrullah, F., Maslami, V., & Hasma, H. (2024). Nutrient Content of Corn Straw (Crude Fibre, Crude Fat and TDN) Caused by Different Doses of Urea. *Jurnal Pijar Mipa*, *19*(4), 673–677. https://doi.org/10.29303/jpm.v19i4.6643

urea dosage on the chemical composition of corn straw, farmers and the animal feed industry can make more informed decisions in utilizing it as an efficient and quality animal feed.

Research Methods

Tools and Materials

The production of ammoniated corn straw uses tools such as black plastic for incubation, straps, machetes for cutting and chopping corn straws, and laboratory equipment for analyzing crude fiber and crude fat content. Meanwhile, the materials used include corn straw, urea, and chemicals needed for proximate analysis.

Research Methods

The method applied was to conduct a proximate analysis of crude fibre and fat content based on the AOAC method [8]. The research process included making ammoniated corn straw, where 500 grams of chopped corn straw was weighed, then urea with different doses was added. This mixture was then spread evenly into plastic and incubated for 21 days [5]. In addition, tools and materials were prepared, and proximate analyses were conducted. The research design used a completely randomized design (CRD) with four treatments (different doses of urea) and four replicates, namely T1=0% (control), T2=2%, T3=4%, and T4=6%.

Observed Parameter

Parameters observed were crude fibre, crude fat [8], and TDN content [9]. Calculations were made using the formulas in equations 1, 2, and 3.

$$\text{Crude Fiber (\%)} = \frac{Q - R - O}{P} \times 100\% \quad [8]$$

$$\text{Crude Fat (\%)} = \frac{M - N}{L} \times 100\% \quad [8]$$

EMWN (%) = 100% – (% water content + % ash + % crude fat + % crude protein + % crude fiber)

TDN (%) = 70.6 +0.259*crude protein + 1.01* crude fat – 0.76*crude fiber + 0.091 BETN. [9]

Note:
O = filter paper after 105ºC oven (gr)
P = sample (gr)
Q = sample+filter paper after 105ºC oven (gr)
R = sample+filter paper after 600ºC tanur (gr)
L = sample (gr)
M = sample+filter paper after 105ºC oven (gr)
N: sample+filter paper (soxhlet) after 105ºC oven (gr)
EMWN: Extract Material Without Nitrogen
TDN: Total Digestible Nutrient

Data Analysis

Data were analyzed using the ANOVA test to assess whether there was a significant effect and differences between the treatments using the DMRT follow-up test [11] and the help of SAS software [10].

Results and Discussion

Crude Fiber

Crude fibre combines all indigestible fibres, including cellulose, pentose, lignin, and other ingredients. Crude fibre content analysis aims to determine the amount of crude fibre in the diet, with the main principle involving the binding of water, cellulose, and pectin. Crude fibre is part of the feed that cannot be broken down by chemicals such as sulphuric acid and sodium hydroxide. Figure 1 displays the crude fibre content of ammoniated corn straw.

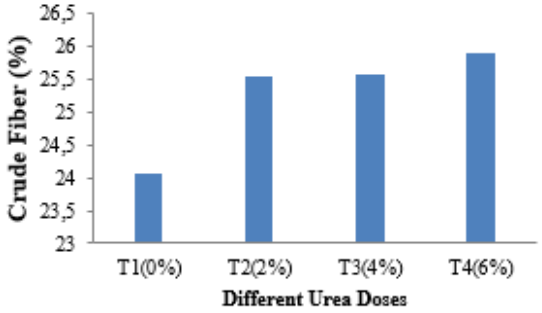

Figure 1. Crude fiber content of ammoniated corn straw

The analysis of variance showed that urea addition had a significant impact (P<0.05) on the crude fibre content in corn straw. An increase in urea level is associated with increased crude fibre content. This is due to a decrease in the levels of lignin, one of the components of ADF and crude fibre. Lignin, although not a carbohydrate, is often closely related to cellulose and hemicellulose and has a strong relationship with crude fibre in proximate analysis. A decrease in lignin content leads to an increase in fibre fractions such as hemicellulose and cellulose, increasing crude fibre content. This view agrees with the theory that a decrease in the proportion of lignin in feed leads to an increase in other fibre fractions, such as cellulose and hemicellulose, increasing the crude fibre content. Crude fiber, which mainly contains cellulose and only partly lignin, tends to increase cellulose and hemicellulose content.

Furthermore, [12] explains that increasing the proportion of cellulose and hemicellulose fibre fractions will also increase the crude fibre content while decreasing the proportion of these fractions will reduce the crude fibre content. This is because crude fibre consists of cellulose, hemicellulose, and lignin. According to the results of the analysis in the INMT laboratory of the Faculty of Animal Husbandry, Mataram University [13], urea reduces the content of cellulose, hemicellulose, and lignin.

The results of further analysis using Duncan's test showed that the treatments produced significant differences (P<0.05) due to variations in the level of urea addition during ammoniation of corn straw, resulting in variations in crude fibre content in each treatment. The control (T1) showed an average crude fibre content of 24.05%, while adding urea from 2% to 6% successively increased the crude fibre content to 25.53%, 25.57%, and 25.91%. The treatment with 6% urea addition (T4) gave the highest

crude fibre content of 25.91%. This finding is consistent with the results of [14], which showed an increase in crude fibre content from 33.2% to 35.19% when the straw was treated with urea at the highest level, 4%. The use of urea dose of 6% caused an increase in crude fibre content. This occurs because during the ammoniation process, urea breaks down into ammonia, which interacts with lignocellulose and lignohemicellulose bonds and changes the cell wall structure [3].

Crude Fat

Fat is a collection of natural molecules comprising carbon, hydrogen, and oxygen. According to [15], crude fat extracted from chlorophyll, xanthophyll, and carotene results from crude fat determination. The Soxhlet method is used to determine feedstuff fat content by using hexanes as solvents in the extraction process [16]. The function of N-hexan is to extract fat or dissolve fat, thus changing the colour from yellow to clear (Mahmudi,1997) [17]. Figure 2 displays the crude fat content of ammoniated corn straw.

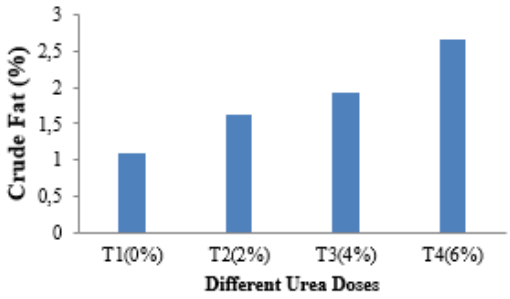

Figure 2. Crude fat content of ammoniated corn straw

The analysis of variance showed that the addition of urea in the ammoniation process of corn straw had a significant effect (P<0.01) between all treatments. Crude fat content ranged from 1.09% to 2.65%. The percentage value of crude fat content in T2 (1.62%), T3 (1.95%), and T4 (2.65%) was higher than in T1 (1.09%). The increase in crude fat content is due to the breakdown of the cell wall structure, in accordance with the opinion that states that the rise in crude fat content is caused by the breakdown of crude fibre content during the ammoniation process [18].

The results of further analysis using Duncan's test showed highly significant differences (P<0.01) between treatments due to varying levels of urea addition during ammoniation, resulting in differences in crude fat content in each treatment. Crude fat content after ammoniation increased, with T1 (1.09%%), T2 (1.62%), T3 (1.94%), and T4 (2.65%). The treatment with 6% urea added (T4) showed the highest crude fat content at 2.65%, with increasing urea levels correlating with increasing crude fat content. It is suspected that the increase in crude fat content is related to the increase in crude protein content, as revealed by [19], which states that an increase in crude fat can be caused by an increase in crude protein and a decrease in fibre fractions, such as ADF which is marked by a reduction in lignin content. Previous research also showed an increase in crude protein content and a decrease in lignin, affecting the increase in crude fat. The lower the lignin content, the higher the digestibility rate, and the more excellent the opportunity to be used as a feed source.

Despite the increase, the crude fat content in this study was still within the normal range of 2.65%, which is still in accordance with the recommendations for crude fat content in feed, which should not exceed 5% [20]. Fat content that exceeds 5% can cause a decrease in the microbial population in the rumen.

TDN (Total Digestible Nutrient)

TDN represents the total energy obtained from livestock feed consumption. The magnitude of this energy value depends on how well the organic matter of the feed is digested, with nutrients such as crude protein, crude fibre, crude fat, and BETN playing a role [21]. Figure 3 displays the TDN content of ammoniated corn straw.

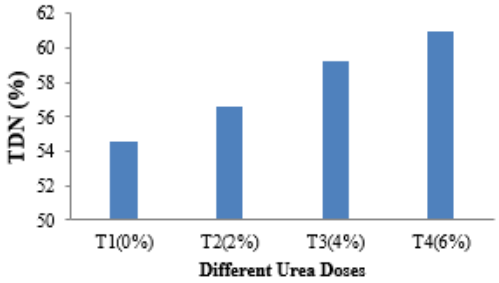

Figure 3. TDN content of ammoniated corn straw

The analysis of variance showed that the treatments had a highly significant impact (P<0.01) on TDN levels. The average TDN value of corn straw ranged from 56.60% to 60.91%. The TDN percentage of corn straw after ammoniation was higher than before, at 54.60%. This indicates that increasing the level of urea in the ammoniation process of corn straw can increase the TDN content. This increase in TDN occurs due to increased crude fat content, as revealed by [22], which states that an increase in ash, crude protein, and crude fat will increase TDN.

The results of further analysis using Duncan's test showed highly significant differences (P<0.01) between treatments due to variations in the level of urea addition during ammoniation, which resulted in differences in TDN content in each treatment. In T1 (54.60%), T2 (56.54%), T3 (59.22%), and T4 (60.91%). In other words, the higher the level of urea given, the higher the TDN level. This phenomenon reflects the high level of digestibility in each treatment, so the amount of nutrients that can be absorbed also increases.

TDN content in this study has increased. The increase in Total Digestible nutrients occurred due to the rise in crude fat. By the view [23], the high TDN value in each treatment is likely due to the content of nutrients such as crude fat, which is relatively high, considering that the energy produced by fat is 2.25 times higher than other components so that it can increase the TDN value. The average TDN results in this study ranged from 54.60% to 60.91%. This is in contrast to the results of other research, which reached 57.11% [24]. The quality requirement for dairy cattle feed is a minimum TDN of 75% [25] and a minimum TDN of 68% for cattle feed [26].

Conclusion

Different doses of urea in ammoniated corn straw can increase the content of crude fibre, crude fat and TDN to increase the digestibility and utilization of corn straw as an alternative feed for ruminants. The best urea dose is at 6%, with results of 25.91% crude fibre; 2.65% crude fat, and 60.91% TDN respectively. Further research recommendations are to see more clearly the effect of urea on the quality of corn straw as feed, and in-vitro digestibility tests can be carried out.

Acknowledgments
We would like to thank LPPM (Institute for Research and Community Service) of Mataram University for the funding provided through DIPA BLU (Number: 2261/UN18.L1/PP/2023).

References

[1] Yanuartono., Indarjulianto, S., Nururrozi, A., & Raharjo, S. (2020). Metode Peningkatan Nilai Nutrisi Jerami Jagung Sebagai Pakan Ternak Ruminansia. *Ternak Tropika*, *21*(1), 23-38.

[2] Pasue, I., Saleh E.J, & Bahri S. (2019). Analisis lignin, selulosa dan hemi selulosa jerami jagung hasil di fermentasi trichoderma viride dengan masa inkubasi yang berbeda. *Jambura Journal of Animal Science*, *1*(2), 62-67.

[3] Noersidiq, A., Marlida, Y., Zain, M., Kasim, A., Agustin, F., Frederick, A & Huda, N. (2018). The Roles of Ammoniation, Direct Fed Microbials (DFM) and Cobalt (Co) in the Creation of Complete Cattle Feed Based from Oil Palm *Journal of Agrobiotechnology*, *9*(2), 92–107.

[4] Noersidiq, A., Marlida, Y., Zain, M., Kasim, A., Agustin, F., & Huda, N. (2020). The effect of urea levels on in-vitro digestibility and rumen fermentation caharacteristic of ammoniated oil palm trunk. *International Journal on Advanced Science Engineering Information Technology*, *10*(3), 1258-1262.

[5] Noersidiq, A., S H Dilaga, Suhubdy, M Amin, Fahrullah, V Maslami. (2023). Urea's Effect on Dry Matter, Organic Matter, and Crude Protein Content of Ammoniated Corn Straw. *Jurnal Biologi Tropis*,*23*(4), 76–81.

[6] McDonald, P., Edwards, R.A., & Greenhalg, J.P.D. (2002). Animal Nutrition. sixth Ed. Prentice hall. Gosport. London. Pp : 427-428.

[7] Khattab, I.M., Salem, A.Z.M., AbdelWahed, A.M. and Kewan, K.Z. (2013). Effects of urea supplementation on nutrient digestibility, nitrogen utilisation and rumen fermentation in sheep fed diets containing dates. *Livestock Science*,155,223–229.

[8] AOAC. (2019). Official methods of analysis of the Association of Official Analytical Chemists 21st Edition. Washington DC

[9] Sutardi, T. (1980). Landasan Ilmu Nutrisi. Departemen Ilmu dan Makanan Ternak Fakultas Peternakan. Institut Pertanian Bogor. Bogor

[10] SAS institute Inc. (2008). SAS user's guide, Version 9.1,second ed. SAS Institute Inc. Cary, NC.

[11] Steel, R.G.D & J.H. Torrie. (1993). Prinsip dan Prosedur Statistika.Gramedia. Jakarta.

[12] Bina, M. R. (2023). Kandungan Selulosa, Hemiselulosa dan Lignin Silase Ransum Komplit dengan Taraf Jerami Sorgum (Sorghum bicolor (L.) Moench) yang Berbeda. *Gorontalo Journal of Equatorial Animals*, *2*(1), 44-53.

[13] Laboratorium INMT (Ilmu Nutrisi dan Makanan Ternak). (2023). Hasil analisa kandungan komponen jerami jagung. Fakultas Peternakan Universitas Mataram (*unpublished*).

[14] Enawati, L. S., Nalley, W., Suryatni, N. P. F., &Malik, A. K. (2021). Penyiapan pakan ternak sapi berbasis limbah jagung pada kelompok tani usaha bersama kelurahan babau, kecamatan kupang timur, kabupaten kupang. *Jurnal Pemberdayaan Masyarakat Petani*, *2*(1),150-160.

[15] Khairul. (2009). Ilmu Gizi dan Makanan Ternak. Penerbit Angkasa Bandung.

[16] Soejono,M. (1990). Petunjuk Laboratorium Analisis dan Evaluasi Pakan. Fakultas Peternakan Universitas Gadjah Mada, Yogyakarta

[17] Mahmudi, M. (1997). Penurunan Kadar Limbah Sintesis Asam Phospat Menggunakan Cara Ekstraksi Cair-Cair dengan Solven Campuran Isopropanol dan nHeksane. Semarang: Universitas Diponegoro

[18] Choiriyah, S., Praptiwi, I. I., & Muchlis, D. (2018). Pengaruh Pemberian Aras Urea pada Amoniasi Rumput Palungpung (*Phragmites Karka*) Terhadap Kandungan Serat Kasar, Protein Kasar, dan Lemak Kasar. *Jurnal Universitas Musamus*, *1*(1), 27‑32.

[19] Suningsih N, W. Ibrahim, O. Liandris, & R. Yulianti. (2019). Kualitas Fisik dan Nutrisi Jerami Padi Fermentasi pada Berbagai Penambahan Starter. *Jurnal Sain Peternakan Indonesia*,*14*(2), 191-200.

[20] Haryanto, B. (2012). Perkembangan Penelitian Nutrisi Ruminansia. *Jurnal Wartazoa*, *22*(4), 169‑177.

[21] Hermanto, 2001. Pakan Alternatif Sapi Potong. Dalam Kumpulan Makalah Lahirnya Kajian Teknologi Pakan Ternak Alternatif. Pakan Ternak Alternatif. Fakultas Peternakan Universitas Brawijaya. Dispet Propinsi Jatim, Surabaya.

[22] Indah, A. S., Permana, I. G., & Despal. (2020). Model Pendugaan Total Digestible Nutrient (TDN) pada Hijauan Pakan Tropis menggunakan Komposisi Nutrien. Sains Peternakan. *Jurnal Penelitian Ilmu Peternakan*, *18*(1), 38‑43.

[23] Sutrisno, Surono,Afliha, K. (2020). Pengaruh Suplementasi Probiotik Isi Rumen Kerbau dengan Level Berbeda terhadap Nilai Kecernaan dan TDN pada Domba Balibul. *Jurnal Litbang Provinsi Jawa Tengah*, *18*(2), 181‑190.

[24] Mastopan,M. Tafsin, & Hanafi, N.D. (2014). Kecernaan lemak kasar dan TDN (Total Digestible Nutrient) ransum yang mengandung pelepah daun kelapa sawit dengan perlakuan fisik, kimia, biologis dan kombinasinya pada domba. *Jurnal Peternakan Integratif*, *3*(1), 37-45.

[25] Badan Standarisasi Nasional. (2017). StandartNasional Indonesia (SNI) Pakan konsentrat-Bagian 1:Sapi perah SNI 3148-1. Jakarta.

[26] Badan Standarisasi Nasional. (2017). StandartNasional Indonesia (SNI) Pakan konsentrat-Bagian 2:Sapi potong SNI 3148-2. Jakarta.