แก่นเกษตร KHON KAEN AGRICULTURE
JOURNAL KAJ

Improving the nutritive values of corn dust by urea and molasses treatment as ruminant feed

Ratchataporn Lunsin[1]*, Damrongchai Sokantat[1] and Jirapa Manop[2]

[1] Program in Animal Science, Faculty of Agriculture, Ubon Ratchathani Rajabhat University, Ubon Ratchathani, Thailand 34000

[2] Faculty of Agriculture, Ubon Ratchathani Rajabhat University, Ubon Ratchathani, Thailand 34000

* Corresponding author: ratchataporn.l@ubru.ac.th

ABSTRACT: The experiment was conducted to investigate the effect of urea and molasses treatment of corn dust on physical quality and chemical composition for its usage as ruminant feed. The experimental design was 4x4 factorial arrangement in a Completely Randomized Design (CRD). The first factor was urea (U) treatment at 0, 2, 4, and 6%, respectively, and the second factor was molasses (M) treatment at 0, 2, 4, and 6%, respectively. Corn dust was taken to treat with urea and molasses solution according to the treatments and ensiled in a plastic bag at room temperature for 15 days. Ensiled con dust was examined by physical quality parameters and chemical composition. The results showed that the odour of ensiled corn dust was rated very good with light ammonia, and the colour was brown when adding 2-4% urea in combination with molasses. Furthermore, the pH value and chemical composition had affected by urea supplement ($P<0.01$). Increasing urea level increase the pH and CP content of ensiled corn dust, which was highest in 6% urea. Whereases, chemical composition of NDF and ADF were decrease by urea treatment, and was lowest in 6% urea. Although molasses treatment had no affected on the quality of ensiled corn dust, the OM was increased when molasses was added. However, there were no interaction of urea and molasses treatment on pH and nutritive value of ensiled con dust. Therefore, treatment with urea and molasses improve the quality of corn dust for suitable used as ruminants feed.

Keywords: chemical composition; corn dust; physical quality; ruminant feed

Introduction

During the dry season, there is often a shortage of animal feed in both quality and quantity. In this season, most livestock farmers have focuses on the preservation and utilization of alternative feeds for animal such as crop residue and agro-industrial by-products. Corn dust is commonly available by-product of corn milling factories which has potential as an alternative feed resource for feeding ruminants. It is containing 8.4-8.8% CP with 40.7-42.6% NDF and 16.4-17.0% ADF (Lunsin et al., unpublish). However, the potential use of corn dust as a ruminant feed may be realized through the development of some treatments. According to Wanapat et al. (1996) who noted that the utilization of poor-quality feed can be improved either nutritionally by supplementation or technologically, by using treatments. Urea and molasses treatments are considered effective to improve the nutritive value of several agro-industrial by-product such as cassava pulp and sugarcane bagasse. For example, Lunsin et al. (2018) indicated that a combination of 5% urea and 5% molasses treated sugarcane bagasse could improve the nutritive value and *in vitro* fermentation with increased CP content and *in vitro* DM and OM digestibility. Norrapoke et al. (2017) reported that urea and molasses supplement could improve the nutritive value of treated cassava pulp, and the increasing level of urea supplement could increase CP and decrease fiber contents of treated cassava pulp ($P < 0.05$). Moreover, supplementation of urea and molasses could improve the quality of whole-crop rice silage in terms of nutritive value and rumen degradation (Wanapat et al., 2013).

It is widely known that feed conservation plays a pivotal role in productive and efficient ruminant livestock production (Keng et al., 2018). Therefore, the objective of this experiment was to determine the effects of urea and/or molasses treatment of corn dust on its physical quality and nutritive value.

Materials and Methods

Experimental design and treatments

The experiment design followed the Completely Randomized design (CRD) with 4x4 factorial arrangement of treatments. There were two factors as follows; the first factor was urea treatment at 0, 2, 4 and 6%, respectively, and the second factor was molasses treatment at 0, 2, 4 and 6%, respectively. There were three replications of each treatment.

Corn dust was taken to treat with urea and molasses solution according to the treatments. Liquid solution was prepared by dissolved urea and molasses (w/w) with 10 liters of distilled water, then spayed and mixed well with 10 kg (DM basis) of corn dust. The mixtures were carefully packed into the plastic bags and compressed by hand to remove as much air as possible. Each bag was tightly tied and put into a second empty plastic bag which was also tied to protect it from rupturing and left undisturbed at room temperature for 15 days.

Sample collection and analysis

The silages were opened at 15 days after ensiling. The colour and smell of silages thus obtained were noted immediately after the bags were opened. The silages were sampled about 500 g of total fresh weight, then divided into three parts; the first part was soaked in distilled water and store at 5 °C for 1 day for pH measurement by using probable pH meter. The second part was for analysis of dry matter (DM) by hot air oven at 100 °C for 48 h (AOAC, 1990). The third sample was dried by hot air oven at 60 °C for 48 h then ground to pass a 1 mm sieve for chemical analysis of crude protein (CP) and ash according to AOAC (1990); neutral detergent fiber (NDF) and acid detergent fiber (ADF) according to Van Soest et al. (1991).

Statistical analysis

All data were subjected to the General Linear Models (GLM) procedures of SAS (2006) according to a 4 × 4 factorial arrangement in CRD. Differences among mean was tested by Duncan's New Multiple Range Test (DMRT) (Steel and Torrie, 1980) with $P<0.05$ was accepted as representing statistically significant differences.

Results and Discussions

The effect of urea and/or molasses treatment on physical quality parameters are presented in **Table 1**. The odour of ensiled corn dust was rated very good, good and bad based on urea and molasses treatment. Based on urea treatment, the odour was rated very good with light ammonia when 2-4% urea was added. Whereas, adding 6% urea in combination with molasses had badly odour regardless molasses dose (0, 2, 4 and 6%, respectively). Moreover, the colour was varied based on the level of urea and molasses used, mostly brown or dark brown. The brownish black and dark black was found in 6% urea in combination with molasses regardless used dose.

The urea and molasses used influenced the pH value and chemical composition of ensiled corn dust as shown in **Table 2**. Urea addition significantly increased ($P<0.01$) the pH value of ensiled corn dust, and the highest pH value was record in 6% urea (pH 8.9-9.0). These findings are in agreement with previous

studies by Kang et al. (2018) who found that the addition of 0.5 and 1% urea increased the pH of cassava top silage when compare to 0% urea supplement (P< 0.05). The urea supplementation in corn dust improved the nutritive value by increase CP and decrease fiber content (NDF and ADF) in a dose-dependent manner (P<0.01), but these parameters were not influenced by the addition of molasses. The highest CP (20.9-21.5%), and lowest NDF (33.1-33.4%) and ADF (12.6-12.8%) were observed in the treatment of 6% urea added. The improvement in feeding value of ensiled corn dust as effect by urea treatment could have been due to the fact that urea treatment enhanced the nitrogen content of lignocellulosic materials and consequently free ammonia was released, which reacted with the lignocellulosic materials by reducing cell wall components (NDF and ADF) (Lunsin et al., 2018). The DM and EE content were not significantly different (P>0.05) among treatments in both urea and molasses treatment. As for molasses treatment, there were no significantly different among treatments (P>0.05) on pH and chemical composition, except for OM was significantly increased when increasing level of molasses supplement (P<0.05). The results of molasses treatment on pH value in this study was in the agreement with the study of Wanapat et al. (2013) who found that no effect of molasses addition on the pH of whole-crop rice silage. In addition, there were no effects of urea and molasses interaction on pH and nutritive values of ensiled corn dust.

Table 1 The physical quality parameters of urea and molasses treated corn dust

Treatment		Odour	Colour
T1	U0 M0	good	gray brown
T2	U0 M2	very good	brown
T3	U0 M4	very good	dark brown
T4	U0 M6	very good	brownish black
T5	U2 M0	good	light brown
T6	U2 M2	good	brown
T7	U2 M4	very good	dark brown
T8	U2 M6	very good	dark brown
T9	U4 M0	good	dark brown
T10	U4 M2	very good	brown
T11	U4 M4	very good	brown
T12	U4 M6	very good	brown
T13	U6 M0	bad	brownish black
T14	U6 M2	bad	brownish black
T15	U6 M4	bad	brownish black
T16	U6 M6	bad	dark black

U=urea, M=molasses

Table 2 The pH value and chemical composition of urea and molasses treated corn dust

Treatment		pH	DM (%)	OM	CP	EE	NDF	ADF
				%DM				
T1	U0 M0	3.8^{e}	46.4	93.2^{e}	11.0^{d}	3.56	35.6^{a}	16.2^{a}
T2	U0 M2	3.7^{e}	44.1	93.3^{cde}	11.1^{d}	2.75	35.3^{ab}	16.1^{a}
T3	U0 M4	3.7^{e}	45.6	93.7^{abcde}	11.5^{d}	2.84	35.9^{a}	15.7^{ab}
T4	U0 M6	3.6^{e}	43.5	93.9^{abcd}	11.3^{d}	3.51	35.8^{a}	15.3^{ab}
T5	U2 M0	4.5^{d}	44.2	93.5^{bcde}	14.9^{c}	3.66	35.2^{ab}	15.9^{ab}
T6	U2 M2	4.5^{d}	45.8	93.8^{abcd}	15.0^{c}	3.32	35.1^{ab}	15.6^{ab}
T7	U2 M4	4.4^{d}	45.5	94.0^{abcd}	15.1^{c}	2.90	35.0^{abc}	14.4^{bc}
T8	U2 M6	4.4^{d}	43.9	94.1^{abc}	15.2^{c}	3.49	34.9^{abcd}	14.6^{abc}
T9	U4 M0	5.7^{b}	46.0	93.3^{de}	17.2^{b}	2.34	34.1^{bcde}	13.7^{c}
T10	U4 M2	5.6^{bc}	45.3	93.6^{bcde}	17.3^{b}	3.24	33.9^{cde}	13.2^{c}
T11	U4 M4	5.5^{bc}	45.0	93.8^{abcde}	17.4^{b}	3.30	33.6^{ef}	13.4^{abc}
T12	U4 M6	5.4^{c}	43.8	94.2^{ab}	17.4^{b}	3.58	33.7def	13.0^{abc}
T13	U6 M0	9.0^{a}	44.6	93.4^{cde}	20.9^{a}	3.04	33.4^{efg}	12.8^{c}
T14	U6 M2	9.0^{a}	45.3	93.9^{abcd}	21.1^{a}	3.09	32.6^{fgh}	12.6^{c}
T15	U6 M4	8.9^{a}	45.2	94.0^{abcd}	21.3^{a}	3.42	32.2^{gh}	12.7^{c}
T16	U6 M6	8.9^{a}	43.4	94.3^{a}	21.5^{a}	3.20	32.1^{h}	12.6^{c}
SEM		0.16	0.32	0.27	0.57	0.09	0.48	0.41
Urea		**	ns	ns	**	ns	**	**
Molasses		ns	ns	*	ns	ns	ns	ns
Urea* Molasses		ns	ns	ns	ns	ns	ns	ns

U=urea, M=molasses, ^{a,b,c,d,e,f,g,h}=Mean within columns with different superscript letters differ (P<0.05), *P<0.05, **P<0.01, ns=non-significant, SEM= standard error of the mean

Conclusions and Recommendations

From the results, it can be concluded that the nutritive value of corn dust could be enhanced by urea and molasses treatment. Urea treatment ensured the quality of ensiled corn dust by increasing CP and reducing fiber content, whereas molasses treatment improved OM content of ensiled corn dust. Based on the physical quality parameters and chemical composition, using 4% urea in combination with 2-6 % molasses are the best options for improving the nutritive values of corn dust as silage for feeding ruminants. However, further research should be conducted on the use of ensiled corn dust in production trials to evaluated the effect of this product on animal performance.

Acknowledgments

The authors would like to express their most sincere gratitude and appreciation to Faculty of Agriculture, Ubon Ratchathani Rajabhat University for providing research facilities.

References

AOAC. 1990. Official methods of analysis of the Association of Official Analytical Chemists. 15th edition. Washington, DC, Association of Official Analytical Chemists.

Kang, S., M. Wanapat, and A. Nunoi. 2018. Effect of urea and molasses supplementation on quality of cassava top silage J. Anim. Feed Sci. 27(1): 74–80.

Lunsin, R., S., Duanyai, R., Pilajun, S., Duanyai, and P. Sombatsri. 2018. Effect of urea- and molasses-treated sugarcane bagasse on nutrient composition and *in vitro* rumen fermentation in dairy cows. Agr. Nat. Resour. 52(5): 622-627.

Norrapoke, T., M. Wanapat, A. Cherdthong, S. Kang, K. Phesatcha, and T. Pongjongmit. 2018. Improvement of nutritive value of cassava pulp and *in vitro* fermentation and microbial population by urea and molasses supplementation. J. Appl. Anim. Res. 46(1): 242-247.

SAS. 2006. Procedures Guide, second ed. SAS Institute Inc., Cary, NC, USA.

Steel, R.G.D., and J.H. Torrie. 1980. Principles and Procedures of Statistics. McGraw Hill Book Co, New York, USA.

Van Soest, P.J., J.B. Robertson, and B.A., Lewis. 1991. Methods for dietary fiber neutral detergent fiber and non-starch polysaccharides in relation to animal nutrition. J. Dairy Sci. 74: 3583-3597.

Wanapat, M., M. Chenost, F. Munoz, and C. Kayouli. 1996. Methods for improving the nutritive value of fibrous feed: treatment and supplementation. Annales de zootechnie, INRA/EDP Sciences. 45 (Suppl1): 89-103.

Wanapat, M., S. Kang, P. Khejornsart, and R. Pilajun. 2013. Improvement of whole crop rice silage nutritive value and rumen degradability by molasses and urea supplementation. Trop. Anim. Health Prod. 45(5): 1–5.