EFFECT OF DIFFERENT CHEMICAL TREATMENETS ON NUTRITIVE VALUE OF SORGHUM STOVERS AS RUMINANT FEED (IN SITUE STUDY)

Abdul- Rahman H. Nassar
Faculty of Agriculture - Sana'a University

Kay words:**Sorghum stovers, Chemical treatments, Degradability**

Abstract:

This study was carried out in the Faculty of Agriculture, Sana'a University, to evaluate the effect of four chemical treatments; sodium hydroxide (NaOH), hydrogen peroxide (H_2O_2), ammonium hydroxide (NH_4OH) and urea, on the nutritive value of sorghum stovers (kassar and husher) which represent the most common source of ruminant animal feed under Yemeni condition.

All alkali treatments significantly increased ($P< 0.05$) both stovers fiber fraction contents (ADF and NDF), with the NaOH treatment having the highest significant effect ,while urea treatments appeared to have a low effect on such parameters. However, the obtained results showed that urea treatment significantly ($P<0.05$) has increased both kassar and husher stovers crude protein content.

In the in situ study all chemical treatments increased significantly ($P<0.05$), DM disappearance rates at different incubation times (24, 48 and 72 h.). Highest improvement in DM disappearance values of kassar and husher stovers obtained with the NaOH treatments. When urea treatments showed to moderately improve ($P<0.05$) DM disappearance of both treated stovers.

Introduction:

In the Republic of Yemen (ROY) the unavailability of sufficient range land which is capable of providing forage year around, the scarcity of locally produced grain and the high cost of imported supplies make the possibility of feeding ruminant animals balanced diets which promote good productive performance, specially under farmers condition, unfeasible. Therefore, ruminants in the ROY as well as in most other Arab countries commonly fed crop residues that are in rate cases supplements with concentrates (AOAD, 1997).

According to a FAO report about Yemen livestock (1993), crop residues represent over 50 percent of available animal feed and sorghum stovers constitute around 57 percent of such a share. Stover residues in the ROY come from several local varieties of sorghum grain which could be divided, according to the length of their plant stalks, into two major groups; short (80-120 cm) and long (250-300 cm) stalk varieties. Stalks of the long stalk varieties are usually cut after crop harvest into two parts ; upper part (100-150 cm) and lower part (150 - 200 cm) in length which are under this study called kassar and husher, respectively. Kassar part is used by Yemeni farmers as the main source of feed year around. While husher part, due to it's very poor nutritive value, is usually used by women farmers as fuel. The husher part of sorghum stovers might be offered for ruminants, specially Cattle, during sever draught periods where there is no other source of feed is available.

Studies on improving the nutritive value of local crop residues in Yemen are limited. In this regard, the only study that is available is the one that was conducted by (Nabuurs, et al., 1987) using urea solution treatment.

Crop residues represent the structural components of the plant and are composed mainly of a mixture of polysaccharides (primarily cellulose and hemicellulose) which are physically and chemically associated with lignin which negatively influence crop residue digestibility as well as general residue nutritive values (Allenson and Dsbourn, 1970; Lechtenberg and colanbrander, 1974).

Chemical treatment that result in lignin removal or lignin dissociation from structural carbohydrates have a great potential in improving digestibility of crop residues by rumen microorganisms. Many chemicals have been used in the treatment of crop residues in order to improve their nutritive values. These include Sodium hydroxide (Garret et al., 1976; Rexan and Thomsen, 1976; Oreskov et al., 1978; Felix, et al, 1990), ammonium hydroxide (Rounds and klopfenstein, 1974; Waller and klopfenstein, 1975), Calcium hydroxide (Oji et al., 1977; Abou - Raya, et al.,1984) potassium hydroxide (Rounds and klopfenstein, 1974), hydrogen peroxide (Gould, 1984 ; kerely et al., 1986) and Urea (Mason and Owen, 1985; Almeda et al., 1989).

Under Arab countries feed situation in general (AOAD, 1996) and Yemeni feed condition in particular (Muller, 1986), improving nutritive value of various available crop residue via different means has a great potential in partially solving the problem associated with scarcity of animal feed. Therefore such means need to be thoroughly

evaluated through specialized research programs for the aim of adopting the most beneficial and practical methods under Yemen condition.

The different chemical treatments have had various degrees of success in improving the nutritive value of different crop residues; however, studies on evaluating the effectiveness of various chemical treatments in improving the nutritive value of locally available crop residues are limited.

The aim of this experiment was to assess the improvement in the nutritive value of sorghum stovers (Kassar and husher) treated with various chemicals in In Situ study with sheep.

Materials and Methods:

a. Sample preparation and chemical composition determination:

Five - one thousand gram samples of sorghum stovers (both kassar and husher) were chopped to 3 cm pieces. Four hundred ml of sodium hydroxide (Na OH), hydrogen peroxide (H2O2) and ammonium hydroxide (NH4OH) of 2% (w/v) concentrations, after adjusting the hydrogen peroxide solution pH to 11.5, and urea solution of 5% (w/v) concentrations were added to 200 gm air dried chopped samples of both stovers. After the addition of chemicals to the samples, a hand mixer was used to ensure that the treated materials are exposed to the chemicals. The treated materials then were left at room temperature overnight (12 hr).

Except for urea treated samples, where they were put in plastic bags which were tightly closed and left under room temperature (23 co) to incubate for 14 days. After the incubation periods, except for the urea treated samples, samples insoluble residues were collected, washed repeatedly until the filtrate became neutral and then samples were oven dried at 103 c° for 24 hr. Urea treated samples were oven dried at 54 c° for 48 hr. All samples then were ground to pass through a hammer mill with screen of 2.5-3.0 mm. One hundred grams of each grounded samples were taken for In Situ study and the rest of the samples were ground to pass through a 1-mm screen and were used for chemical composition determination.

Chemical composition of untreated and treated samples including dry matter (DM), organic matter (OM), crude protein (CP), ether extract (EE), crude fiber (CF) and ash were determined according to A.O.A.C (1980). Fiber fractions; Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined according to Goering and Van Soest (1970).

b. Animals:

Three mature Dhamari sheep males of about 16 kg body weights were used. Each animal was fitted with a rumen connula (40 mm in diameter) about 4 weeks before the experiment was commenced.

c. Feeding and management:

The sheep were kept in individual pen and were fed ad libitum on dried sorghum hay.

d. Nylon bags:

The bags were made initially to a size of 140 × 90 mm of material with pore size of 20-40 micro m. The bags were sewed to have double line of sewing and curved corners.

e. Procedures:

The bags were washed and dried to a constant weight at 100 c. Three grams of ground untreated and chemically treated samples of both kassar and husher stovers were placed in the bags with two replicates for each animal for each treatment. Bags of each replicate then were each tied separately with a 25 cm nylon string. The other end of the string was tied to a wire hook fitted into the cannula of the three sheep. The bags were soaked in warm water for about one minute and them suspended in the sheep rumens. The bags of the first replicate of the five treatments of kassar stover were inserted into the sheep's rumens at the same time and were incubated in rumens for 24 , 48 and 72 hr. At the end of each incubation interval the bags were removed from rumen and washed thoroughly under running tap water until the rinsing water was colorless. They were then dried to constant weight at 105 c°. The same procedures

were repeated for the husher stover as well as for the second's replicates bags of both kasser and husher stovers . Bags containing zero incubation-time samples were treated in a similar way of those containing rumen incubated samples, except that they were not rumen incubated. Finally all samples (DM) was determined. All the followed procedures of In Situ study were in accordance with that of Orskov (1984).

F. Statistical analysis:

Data concerning changes in treated sample chemical composition as well as In Situ (DM) disappearance were statistically analyzed according to Snedecor and Cochran (1980) one - way classification followed by Duncan's multiple - range test to examine the significances among means .

Results and Discussion:

Chemical composition and fiber constituent percentage of untreated kassar and husher sorghum stovers are presented in Tables (1 and 2).

Table (1)
Chemical composition of untreated sorghum stovers

DM composition, %							
Stover	**DM %**	**CP***	**EE**	**CF**	**NFE****	**Ash**	**P**
Kassar	**96.0**	**2.9**	**1.2**	**32.1**	**57.8**	**6.0**	**0.03**
Husher	**96.9**	**1.1**	**1.3**	**38.3**	**55.4**	**3.9**	**0.04**

* Crude protein = N × 6.25.

** Nitrogen free extract calculated by difference.

Table (2)
Fiber constituents of untreated sorghum stovers

Dry matter, %			
Stover	**NDF**	**ADF**	**Hemicellulose**
Kassar	**80.1**	**48.9**	**31.2**
Husher	**85.0**	**54.8**	**30.2**

Kassar stovers showed higher ash content, higher cell content (100-NDF) and higher CP than those of husher stovers (6% , 19.9% and 2.,% versus 3.9%, 15% and 1.1% respectively) on DM basis.

Data concerning the responses of both kassar and husher stovers to the various chemical treatments effect on cell well constituents (NDF and ADF) and CP are listed in Tables (3 and 4).

Table (3)
Effect of chemical treatments on fiber constituents and crude protein of kassar sorghum stovers.

Chemical Composition (%of DM)	Chemical treatments				
	Untreated	NaOH (2%)	H_2O_2 (2%)	NH_4OH (2%)	Urea (5%)
NDF	80.2 [a]	83.5 [b]	84.5 [c]	86.0 [d]	79.8 [a]
ADF	48.6 [a]	58.5 [e]	55.4 [d]	54.4 [c]	52.6 [a]
Hemicellulose	31.5 [d]	25.5 [a]	28.9 [c]	31.3 [d]	27.4 [b]
CP	2.8 [b]	2.3 [a]	2.2 [a]	2.6 [ab]	6.8 [c]

Means with different superscripts in the same raw are significantly ($P < 0.05$) different.

Table (4)
Effect of chemical treatments on fiber constituents and crude protein of husher sorghum stover.

Chemical composition (% of DM)	Chemical treatments				
	Untreated	NaOH (2%)	H_2O_2 (2%)	NH_4OH (2%)	Urea (5%)
NDF	85.2 [a]	87.2 [b]	89.4 [c]	89.8 [c]	85.3 [a]
ADF	55.0 [a]	63.3 [e]	61.5 [d]	57.8 [c]	56.1 [a]
Hemicellulose	30.1 [d]	24.1 [a]	27.8 [b]	33.2 [a]	29.2 [c]
CP	1.2 [b]	0.9 [a]	0.9 [a]	1.2 [b]	3.4 [c]

Means with different superscripts in the same raw are significantly ($P < 0.05$) Different.

In both kind of stovers, all alkali treatments showed to increase ($P<0.05$) NDF and ADF content. While urea treatments appeared to have no influence ($P<0.05$) on such cell wall components. These obtained results are of agreement with (showkry, et al., 1985 ; Abou - Raya, et al., 1984). The decrease in fiber fractions of alkali treated stover samples appeared to be associated with the washing process that treated materials were subjected to after treating them with the tested alkali solutions. Regarding the effect of the chemical treatments on both kassar and husher content of CP, data projected in Tables (3 and 4) indicated that Urea treatments resulted in increasing ($P<0.05$) protein content of both kassar and husher from 2.9% to 6.9% and from 1.1% to 3.3% on (DM basis) respectively. This means that Urea treatments showed to improve CP content of both kassar and husher by a rate of 137% and 200% respectively. Similar results have been reported with various poor quality roughage treated with Urea (Jaysuriya and Perera, 1982; Nabuurs, et al., 1987; Badawi, et al., 1990).

Detailed results and over all means of In Situ DM disappearance of both kassar and husher stovers untreated or treated with different chemicals at different incubation periods in the rumens of sheep are presented in Tables (5 and 6).

Table (5)

Effect of chemical treatments on In Situ dry matter disappearance of kassar sorghum stover over different rumen incubation periods (value ± SD).

Incubation period, hr.					Overall
Treatment	0	24	48	72	mean
Untreated	7.1 ± 1.1^{a}	20.5 ± 3.0^{b}	26.0 ± 1.0^{c}	39.1 ± 4.0^{d}	23.6^{A}
2% NaOH	3.2 ± 0.8^{a}	41.8 ± 6.1^{b}	62.3 ± 2.1^{c}	75.1 ± 4.2^{d}	45.5^{D}
2% H_2O_2	2.8 ± 0.7^{a}	28.4 ± 6.8^{b}	46.2 ± 6.1^{c}	62.3 ± 0.7^{d}	34.8^{B}
2% NH_4 OH	2.6 ± 0.3^{a}	35.6 ± 2.8^{b}	52.7 ± 3.7^{c}	67.2 ± 1.4^{d}	39.4^{C}
5% Urea	10.3 ± 0.5^{a}	27.7 ± 8.4^{b}	41.4 ± 4.1^{c}	58.1 ± 4.2^{d}	34.6^{B}

a,b,c,d Means with different superscripts in the same raw are significantly ($P < 0.05$) different.

A,B,C,D Means with different superscripts in the same column are significantly ($P < 0.05$) different.

Table (6)

Effect of chemical treatments on In Situ dry matter disappearance of husher sorghum stover over different rumen incubation periods (value ± SD).

Incubation period, hr.					Overall
Treatment	0	24	48	72	mean
Untreated	4.2 ± 0.2^{a}	17.1 ± 0.1^{b}	21.3 ± 4.0^{c}	32.1 ± 1.4^{d}	18.7^{A}
2% NaOH	2.3 ± 0.8^{a}	29.3 ± 3.0^{b}	43.4 ± 2.4^{c}	63.5 ± 2.8^{d}	34.5^{D}
2% H_2O_2	3.0 ± 0.4^{a}	15.7 ± 7.3^{b}	24.5 ± 6.2^{c}	44.5 ± 2.1^{d}	22.7^{B}
2% NH_4 OH	1.1 ± 0.1^{a}	21.5 ± 6.0^{b}	34.7 ± 5.0^{c}	48.4 ± 1.4^{d}	26.3^{C}
5% Urea	6.8 ± 1.4^{a}	22.5 ± 1.1^{b}	34.4 ± 2.6^{c}	44.5 ± 1.4^{d}	27.2^{B}

a,b,c,d Means with different superscripts in the same raw are significantly ($P < 0.05$) different.

A,B,C,D Means with different superscripts in the same column are significantly ($P < 0.05$) different.

The obtained results showed that DM Disappearance of both kassar and husher, untreated or treated with various treatments, increased significantly ($P<0.05$) as the period of incubation time increased from 24 to 72 hr.

For kassar stover, all chemical treatments significantly ($P<0.05$) increased DM disappearance measured as an over all means of the incubation times with NaOH treatment appeared to have the greatest positive influence ($P<0.05$), while urea treatment showed to have the lowest rate of DM disappearance with a value of 45.5% as an over all mean for NaOH treatment compared to 34.6% for urea treatment.

For husher stover, again all the chemical treatments significantly ($P<0.05$) improved DM disappearance measured as an overall mean for the experiment incubation times with the NaOH treatment also appeared to have the highest positive effect ($P<0.05$). However, urea treatment here came second after NaOH treatment in its effect on DM disappearance measured as on over all mean of the study incubation periods.

Data presented in both Tables (5 and 6) indicated that the magnitude of the positive response to the studied chemical treatments was higher for kassar stover than for husher stover, which might be related to the poorer nutritive quality of husher stover. These results agree with those reported by (Sundstol, 1985) who showed that both alkali and urea treatments have a positive influence on poor quality roughage digestibility with NaOH treatment has the greatest effect. However, regarding urea treatment; obtained results are not in agreement with those of (Nabuurs, et al., 1985), in

a work with common crop residues in Yemen, including sorghum stovers , whom indicated that urea treatment may have no effect on stovers digestibility. However, the results reached by such researchers might be due to carrying out their work in Dhamar area during winter time when minimum temperature, morefrequently, declines under zero c°. While, urea treatment positive effect on DM digestibility is known to be temperature correlated with a better effect is accomplished for the higher incubation temperature.

Jackson (1978) summarized the reason for the increased nutrient disappearance with alkali treatment as :1) solublized hemicellulose lignin and silica, 2) increases extent of cellulose and hemicellulose digestion and 3) increase rate of cellulose and hemicellulose digestion. However, despite the relative low effect of urea treatment on DM disappearance compared to that of alkali treatment, mainly NaOH, urea treatment has several advantages over the alkali treatment (Jayasuria, 1985) that are 1) easy and cheap process, 2) undesirable excess chemicals evaporate with free excess to air and 3) it also increase the nitrogen content of treated roughage, which are usually poor in crude protein.

Under the condition of this experiment, even though urea treatment has a moderate positive influence on sorghum Stover's degradability rate compared to those of alkali treatments, urea treatment might be more promising chemical method as a mean for improving crop residues as ruminant animal feed under Yemeni farmer's situation.

References:

1- Arabic References :

المنظمة العربية للتنمية الزراعية، (١٩٩٦) . توصيات الدورة التدريبية في مجال **الأساليب الحديثة لتنمية المراعي والأعلاف**. الخرطوم، ديسمبر، ١٩٩٦.

المنظمة العربية للتنمية الزراعية (١٩٩٧). الندوة القومية حول الاستفادة من المخلفات **الزراعية**. الخرطوم، ١٣-١٥ أكتوبر، ١٩٩٧.

2- English References :

A.O.A.C., (1980). **Official Methods of Analysis**. (11th Edition). Association of Official Agricultural Chemists, Washington, D.C.

Abou - Raya, A.K., A.S. Shalaby, Z.M. Abdel-Motagally, O.A. Salem and F.M. Salman, (1984). **Nutritional Studies With modified Ca $(OH)_2$ Method (2/3 Soaked and 1/3 Moistened) Versus Water Boiling with Rice Straw and Maize Stalks. 1) Effect of Treatment on Chemical Composition, Feeding Value and in Situ Digestion**. Proc. First Egyptian - British Conference on Animal and Poultry Production. Zagazig Univ., Fac. Agric., 11 to 13 September.

Allinson, D.W. and D.F. Dsbourn, (1970). **The cellulose-Lignin Complex in Forages and it's Relationship to Forage Nutritive Value**. J. Agric. Sci., 74:23.

Almeida, J.A., A.M. Ferreira and J.M. Ribeiro, (1989). **Conservation and Upgrading the Nutritive Value of Whole - Crop Cereal Silage With Urea as an Ammonia Precursor.** In: Int. Sym. On The Constraints and Possibilities of Ruminant Production in the Dry Subtropics. Cairo, Egypt, 5-7 Nov., 1988. EAAP Publication No 38, 1989.

El-Badawi, A.Y., S.M. Ahmed, H.M. Gado and T.M. El-Bedawy, (1990). **Effect of Urea Treatment on Chemical Composition and in Vitro Organic Matter Disappearance of Some Poor Quality Roughage**. Egypt. J. Anim. Prod., 27:259.

Felix, A., R.A. Hill and B. Diarra, (1990). **In Vitro and in Vivo Digestibility of Soy-bean Straw Treated With Various Alkalis**. Anim. Prod., 51 : 47.

Food and Agriculture Organization (FAO) in cooperation with World Bank, (1993). **Yemen National Livestock Development Project, preparation Report**. FAO / World Bank, Cooperative Investment Center, Report No. 73/93 CP - YEM 43.

Garret, W.N., H.G. Walker, G.O. Kohler and M.R. Hart, (1976). **Feedlot Response of Beef Steers to Diets Containing NaOH or NH_3 Treated Rice Straw**. 15th California Feeders Day Proc., University of California at Davis, P. 39.

Goering, H.K. and P.I. Van Soest, (1970). **Forage Fiber Analysis (Apparatus, Reagents, Procedure and Some Applications)**. Agriculture Handbooks 379, ARS, USDA, Washington, D.C.

Gould, J.M., (1984). **Alkaline Peroxide Delignification of Agricultural Residues to Inhance Enzymatic Saccharification**. Biotechnol. Bioeng., 26:46.

Jackson, M.G., (1978). **Treating Straw for Animal Feeding, an Assessment of it's Technical and Economic Feasibility**. FAO animal production and health paper No. 10.

Jayasuriya, M.C., (1985). **Potential for the Better Utilization for Crop Residues and Agro-industrial By-Products in Animal Feeding in the Indian Sub-Continent**. Better utilization of crop residues and by-products in Animal feeding. Research guidelines. FAO animal production and health, paper No. 50.

Jayasuriya, M.C., and H.G. Perera, (1982). **Urea- Ammonia Treatment of Rice Straw to Improve it's Nutritive Value for Ruminants**. J. of Agric. Wastes, 4:143.

Kerley, M.S., G.C. Fahey, Jr., L.L. Berger, N.R. Merchen and J.M. Gould, (1986). **Effects of Alkaline Hydrogen Peroxide Treatment of Wheat Straw on Site and Extent of Digestion in Sheep**. J. Anim. Sci., 63:868.

Lechtenberg, V.L. and V.F. Colenbrander, (1974). **Effect of Lignin on Rate of in Vitro Cell Wall and Cellulose Disappearance in Corn**. J. Anim. Sci. 39:1165.

Mason, V.C. and E. Owen, (1985). **Urea Versus Ammonia for Upgrading Graminaceous Material**. In: Towards Optimal Feeding of Agricultural Byproducts of livestock in Africa. Proceedings of a workshop held at the university of Alexandria, October, 1985.

Muller, Z.O., (1986). **Animal Nutrition Research and Development in Yemen Arab Republic**. Ministry of Agriculture and Fisheries, FAO Project UTFN / YEM/ 011, Agricultural Research Authority.

Nabuurs, S., J. Wensvoort, J. Ferguson and S. Azazi, (1987). **Urea Treatment of Crop - Residues, First Studies at the Dhamar Mountain Plains, YAR**. Range and livestock Improvement project, YAR. Communication No. 19.

Oji, U.I., D.N. Mowat and J.E. Winch, (1977). **Alkali Treatments of Corn Stovers to Increase Nutritive value**. J. Anim. Sci., 44:798.

Orskov, E.R., (1984). **Evaluation of Crop Residues and Agro - Industrial by - Products Using the Nylon Bag Method**. Better utilization of crop residues and by - products in animal feeding : research guide lines, 1. State of knowledge. Proceeding of the FAO / ILCA Expert Consultation, 5-9 March, 1984. ILCA headquarters, Addis Ababa, Ethiopia.

Orskov, E.R., H.S. Soliman and A. Macdearmid, (1978). **In Take of Hay by Cattle Given Supplements of Barley Subjected to Various Forms of Physical Treatment or Treatment With Alkali**. J. Agric. Sci. Camb., 90 : 611.

Rexan, F. and F. Thomsen, (1976). **The Effect on Digestibility of a New Technique for Alkali Treatment of Straw.** Anim. Feed Sci. Technol., 1 : 73.

Rounds, W. and T. Klopfenstein, (1974). **Chemicals for Treating Crop Residues**. J. Anim. Sci, 39 : 251.

Shoukry, M.M., F.A. Hamissa, M. Sawsan, A.H. Ahmed, H.M. El-Refai, H.M. Ali And Z.M. Abdel-Motagally, (1985). **Nutritive Improvement of Some Low Quality Roughage for Ruminants**. I. Effect of different microbial and chemical treatments in the quality of sugar cane bagasse. Egypt. J. Anim. Prod., 25:329.

Snedecor, G.W. and W.G. Cochran, (1980). **"Statistical Methods"** (5th Edition). The Iowa state Univ. Press, Ames., Iowa, U.S.A.

Sundstol, F., (1984). **Procedures for Research into he Treatment of Crop Residues and Agro-Industrial By-products in Developing Countries**. Better utilization of crop residues and by-products in animal feeding : research guide lines, 1. State of knowledge. Proceeding of the FAO / ILCA Expert Consultation, 5-9 march, 1984. ILCA headquarters, Addis Ababa, Ethiopia.

Waller, J.C. and klopfenstein, (1975). **Hydroxides for Treating Crop Residues**. J. Anim. Sci., 41 : 424.

تأثير عدد من المعاملات الكيميائية على القيمة الغذائية لاحطاب الذرة الرفيعة لأستخدامها كأعلاف بعلائق الحيوانات المجترة

عبد الرحمن حسن نصار

كلية الزراعة - جامعة صنعاء

الكلمات المفتاحية: حطب الذرة الرفيعة، معاملات كيميائية، معدل الهدم .

الملخص :

نفذت هذه الدراسة بغرض تقييم تأثير عدد من المعاملات الكيميائية: هيدروكسيد الصوديوم (NaOH) وبيروكسيد الهيدروجين (H_2O_2) وهيدروكسيد الأمونيوم (NH_4OH) واليوريا على القيمة الغذائية لاحطاب الذرة الرفيعة (القصب والحشر) والتي تمثل المصادر الأكثر شيوعاً في الاستخدام كغذاء للحيوانات المجترة تحت ظروف اليمن.

كل المعاملات الكيميائية القلوية معنوياً ($P< 0.05$) تسببت في رفع محتوى أحطاب الذرة الرفيعة من مكونات الألياف الخامة (NDF, ADF) مع تصدر المعاملة (هيدروكسيد الصوديوم) في تأثيرها للمكونات المشار أليها مقارنة ببقية المعاملات. في حين احتلت المعاملة باليوريا المرتبة الأخيرة بسلم التأثير المذكور بالإضافة إلى تسبب المعاملة باليوريا في تحسن معنوي ($P< 0.05$) في محتويات أحطاب الذرة الرفيعة (القصب والحشر) من البروتين الخام.

في دراسة الـ *In Situ* كل المعاملات الكيميائية أدت إلى ارتفاع معنوي ($P<0.05$) في معدل اختفاء (هضم) المادة الجافة (DM) للعينات المعاملة من احطاب الذرة خلال فترات التحضين المختلفة بالكرش (24,48,72 Hr). أعلى معدل هضم للمادة الجافة للحطب المعامل سجل أيضاً للمعاملة بهيدروكسيد الصوديوم في حين تسببت المعاملة باليوريا في مستوى متوسط من التحسن في قيمة معدل الهضم المذكور.