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AMMONIATED POOR QUALITY ROUGHAGE IN PELLETED MIXED DIETS FOR GROWING RABBITS

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SUMMARY

Bean straw and corn stalks were treated by 3% anhydrous ammonia or 5% urea solution (littre/kg), to improve its digestibility and acceptability by growing rabbits. Seventy two male New Zealand White (NZW) growing rabbits were divided into six homogenous groups of average age (6 weeks) and weight (725.1±2.78g), to be used in applied feeding trial conducted to investigate their performance by feeding mixed diets containing untreated or ammoniated bean straw and corn stalks at a rate of 28% bean straw or 31% corn stalks. The results indicated that, growing rabbits consumed higher ($P<0.05$) amounts of the diets containing ammoniated bean straw or corn stalks than those fed untreated one. Feeding experimental diets containing ammoniated bean straw or corn stalks increased significantly ($P<0.01$) daily weight gain also improved feed conversion ratio and efficiency performance index. All digestibility coefficients of rations containing bean straw or corn stalks treated with anhydrous ammonia or urea, increased significantly ($P<0.01$ or 0.05) than that containing untreated materials. Carcass traits showed that hot and cold carcass weight and dressing % were significantly increased ($P<0.05$) in diets containing the ammoniated roughages.

Keywords: *Rabbit, growth, feeding, ammonia, urea*

INTRODUCTION

In the sub-tropical developing countries, there is a gap between available and required animal feeds. In Egypt the gab was estimated to be about 2.9 million tons of TDN as reported by Masoud *et al.* (1990). Moreover, the competition between humans and livestock on concentrates is more obvious. Therefore, improving the nutritive value of poor quality roughages e.g. straws, stalks, and other fibrous agricultural by- products might be one solution for this problem (El-Shazly, 1983). The NaOH treatment was widely used as reviewed by Jackson (1978). The question of pollution due to the NaOH treatment has become a more critical problem. Ammoniation by anhydrous ammonia or urea to produce ammonia has a strong appeal because of less residual alkali, relatively non costic and corrosive to equipments and a source of supplemental nitrogen, furthermore NaOH is excreted with feces and urine causing contamination of the soil (Hertifed and Ali, 1982). Anhydrous ammonia has a great practicability than aqueous ammonia, but the later is more suitable for treating very dry roughages. The developing countries which do not have access to anhydrous or aqueous ammonia will usually have urea available since it is the most common fertilizer.

Urease enzyme which decompose urea to ammonia is present in crop residues e.g. rice straw, corn stalks, bean straw and seed meal (Sundstol and Coxworth, 1984). Ammonia released from urea decomposition would presumably react with the treated roughages (Saadullah *et al.*, 1982). Intensive work have been carried out on the acceptability and digestibility of ammoniated poor quality roughages in ruminants, which showed positive improvement (Waiss *et al.*, 1972 and Saadullah *et al.*, 1982). Increased voluntary intake, growth rate and feed efficiency in both sheep and cattle (Sundstol *et al.*, 1979 and Seed, 1983). A number of digestibility trails have been done with sheep to compare untreated and ammoniated straw which showed an increment in digestibility due to ammoniation which ranged from 8-17% (Jackson, 1978). Nitrogen content increased and showed better utilization in ammoniated roughages (Dryden and Kempton, 1983 and Benahmed and Dulphy, 1985).

Available literature using such treated feedstuffs in rabbit nutrition, are rare. Blas *et al.* (1979); Lindeman *et al.* (1981 and 1982); Jensen *et al.* (1986); Jensen (1988) and Bielanski *et al.* (1996a and b), used untreated and treated roughages (NaOH and NH_3) in mixed diets for rabbits. They reported that the use or NH_3 treated straw in mixtures for rabbits during fattening, improved their growth rate by about 2%, feed conversion rate by 3.8%, decreased feed intake by 6.7% and significantly decreased young rabbit mortality. Also, the result showed that the carcass of experimental animals did not differ from the control group. Moreover, Bielanski *et al.* (1996b) reported that the feeding a herd of does on mixed diets containing ammoniated straw improved reproductive performance, especially litter weight at 21 days, percentage of young reared per litter and milk yield.

This study aimed at the possibility of using untreated and ammoniated (anhydrous ammonia or urea) bean straw and corn stalks in mixtures and its effect on growth, slaughter performance and economical efficiency of growing rabbits.

MATERIAL AND METHODS

This work was carried out at the Rabbit Research Laboratory, while the chemical analyses was performed at the Laboratory of Animal Nutrition, Department of Animal and Fish production, Faculty of Agriculture (El-Shatby), Alexandria, Egypt. The experiment was initiated on April, 2000, and terminated on July, 2000.

Urea treatment

About 220 kg from each of bean straw and corn stalks were chopped using cutting machine to 0.5-1.0 cm, then sprayed by 5% urea solution at rate of 1 liter per kg. Each of these roughages was mixed and covered by polyethylene sheet for 21 days. Urea was decomposed by endogenous urease enzyme in the roughage to ammonia (Sundstole and Coxworth, 1984). The treated materials were aerated for 14 days to get rid of the maximum part of ammonia which existed in the stack. After aeration for 14 days, the treated roughages were mixed with other ingredients to formulate the experimental diets, bean straw urea–concentrate preparation (UBCP) and corn stalks urea-concentrate preparation (UCCP) (Table 2).

Ammonia treatment

Two stacks, with about 2000 kg each, of bean straw and corn stalks were made, after chopping using cutting machine to 0.5-1.0 cm. Each stack was tightly covered with a polyethylene sheet which

Table1. Chemical analysis of untreated and ammoniated bean straw and corn stalks.

Items	Bean straw				Corn stalks	
	Untreated	Anhydrous Ammonia treated	Urea treated	Untreatec	Anhydrous Ammonia treated	Urea Treated
Dry matter	89.45	86.41	85.03	88.74	86.92	84.73
DM composition (%)						
OM	84.69	83.44	84.06	93.72	93.07	93.39
CP	7.62	13.15	12.81	4.75	9.31	9.04
EE	1.72	1.12	1.02	1.63	0.97	0.75
CF	36.84	33.49	34.72	34.67	31.92	32.34
NFE	38.51	36.68	35.51	52.67	49.87	51.80
Ash	15.31	15.56	15.94	6.28	6.93	6.61
Crude fiber fractions (%)						
NDF	81.74	73.55	72.08	78.19	69.41	70.27
ADF	56.11	55.87	55.96	54.13	54.06	53.92
ADL	7.45	7.26	7.11	6.84	6.71	6.54
Cellulose	48.66	48.61	48.85	47.29	47.35	47.38
Hemicellulose	25.63	17.68	16.12	24.06	15.06	16.35

Table 2. Ingredients composition of the experimental diets.

Ingredients	Experimental diets					
	BCP	ABCP	UBCP	CCP	ACCP	UCCP
Bean straw (untreated)	28.0	---	---	---	---	---
Bean straw (ammonia treated)	---	28.0	---	---	---	---
Bean straw (urea treated)	---	---	28.0	---	---	---
Corn stalks (untreated)	---	---	---	31.0	---	---
Corn stalks (ammonia treated)	---	---	---	---	31.0	---
Corn stalks (urea treated)	---	---	---	---	---	31.0
Yellow corn	24.0	24.0	24.0	21.0	21.0	21.0
Wheat bran	12.0	12.0	12.0	10.0	10.0	10.0
Barley grain	11.2	11.2	11.2	10.2	10.2	10.2
Soybean meal (44%)	18.0	18.0	18.0	21.0	21.0	21.0
Sunflower oil	1.0	1.0	1.0	1.0	1.0	1.0
Molasses	4.0	4.0	4.0	4.0	4.0	4.0
Limestone	1.0	1.0	1.0	1.0	1.0	1.0
Common salt	0.5	0.5	0.5	0.5	0.5	0.5
Vitamin & minerals premix*	0.2	0.2	0.2	0.2	0.2	0.2
DL-Methionine	0.1	0.1	0.1	0.1	0.1	0.1
Total	**100**	**100**	**100**	**100**	**100**	**100**

* Vitamins and mineral premix per kilogram contained: Vit. A 2,000,000 IU, Vit. D_3 150,000 IU, Vit E 8.33 g, Vit. B_1 0.33g, B_6 1.7mg, B_2 1.0g, B_5 8.33g, Vit. K 0.33mg, Pantothanic acid 3.33g, Biotin 33mg, Folic acid 0.83g, Choline chloride 200g, Mg 66.7g, Cu 0.5g, I 33.3mg, Se 16.6mg, Zn 11.7g and Fe 12.5g.

BCP : Untreated bean straw plus concentrates. CCP : Untreated corn stalks plus concentrates.

ABCP : Anhydrous bean straw plus concentrates. ACCP : Anhydrous corn stalks plus concentrates.

UBCP: Covered urea bean straw plus concentrates. UCCP:Covered urea corn stalks plus concentrates.

was taken off after 21 days of the injection as described by Hathout *et al.* (1983). After aeration for 14 days, the ammoniated roughages were mixed with other ingredients to formulate the experimental diets, anhydrous ammonia bean straw- concentrate preparation (ABCP) and anhydrous ammonia corn stalks- concentrate preparation (ACCP) (Table 2).

Chemical analysis of untreated and ammoniated bean straw and corn stalks are presented in Table (1).

A total of seventy two male New Zealand White (NZW) growing rabbits of 6 weeks of age of average initial body weight of 725±12.7g, were alloted at random to six homogenous groups each contained twelve rabbits with nearly similar means (insignificant differences) of live body weight. The first and fourth groups were fed on diets containing untreated roughages mixed with other ingredients to formulate the control diets, bean straw – concentrate preparation (BCP) and corn stalks – concentrate preparation (CCP) (Table 2). Group 2, and 3 were fed diets containing bean straw treated with anhydrous ammonia (ABCP) and covered urea (UBCP), respectively. Groups 5 and 6 were fed diets containing corn stalks treated by anhydrous ammonia (ACCP) and covered urea (UCCP), respectively. The ingredients composition and chemical analysis of the experimental diets are summarized in Tables (2 and 3). A commercial vitamin and mineral premix was added for all the experimental diets. All animals were housed (two per cage) in metal galvanized cages under the same managerial conditions and in well ventilated block building. Fresh air circulated in the house using exhaust fans. Temperature during the experimental periods varied between 16 and 22°C employing electrical heaters. The animals were kept within a cycle of 16 h light and 8 h dark using artificial light. Fresh water was automatically available at the time by stainless steel nipples for each cage.

The experimental diets were offered to rabbits *ad libitum* in pelleted form. Live body weight (g) and daily feed consumption (g) were individually recorded each week up to 13 weeks of age (marketing age). Feed conversion ratio was calculated as g feed/g gain. Nutritional and economical parameters and performance traits were estimated. Performance index (PI) was calculated according to Norh (1981) as given below :

PI = [Live body weight (kg) / Feed conversion] x 100

The economical efficiency was calculated by the following equation :-

$Y = [(A - B) / B] \times 100$

where A is selling cost of obtained gain and B is the feeding cost for this gain (cited by El-Kerdawy, 1997).

At the end of the fattening period, six digestibility and nitrogen balance trails were under taken using five rabbits in each group. The average live body weight of rabbits in digestibility trials was 1679±18.9g. Rabbits were kept individually in metabolic cages that allow to collect feces and urine separately. Rabbits of each group were offered one of experimental diets. The trials lasted for 21 days, 14 days as a preliminary period followed by 7 days for measurements of actual consumed feed and feces and urine output. Samples of daily feces (20%) of each rabbit were collected every day, dried at 60-70°C for 48 h, bulked, mixed, finally ground and kept for chemical analysis. Urine was quantitatively collected acid was added to 10% sample of the urine before storing frozen –20 °C for chemical analysis.

Table 3. Chemical analysis of the experimental diets.

Ingredients	Experimental diets					
	BCP	ABCP	UBCP	CCP	ACCP	UCCP
Dry matter	91.86	91.01	90.62	90.64	90.08	89.39
DM basis (%) :						
Organic matter	91.25	91.18	91.05	92.64	92.43	92.54
Crude protein	15.08	16.65	16.57	15.23	16.65	16.40
Ether extract	2.81	2.64	2.61	3.05	2.85	2.78
Crude fiber	13.85	12.91	13.26	13.74	12.89	13.02
Nitrogen free extract	59.51	58.98	58.61	60.62	60.04	60.34
Ash	8.75	8.82	8.95	7.36	7.57	7.46
Crude fiber fractions (%)						
NDF	55.67	53.38	50.19	54.53	48.81	49.07
ADF	24.51	24.44	24.47	22.97	22.94	22.91
ADL	3.64	3.56	3.52	3.31	3.27	3.22
DE (Kcal/kg feed DM)*	2537.90	2568.63	2528.34	2742.30	2739.68	2751.32

* DE (Kcal/kg feed DM) were calculated according to Fekete and Gippert (1986) were:
DE (Kcal/kg) = 4253 – 32.6 (%crude fiber) – 144.4 (% ash).

Table 4. Growth performance of growing NZW rabbits from 6 to 14 weeks of age as affected by feeding mixed diets containing ammoniated bean straw and corn stalks.

Items	Experimental groups						
	BCP	ABCP	UBCP	CCP	ACCP	UCCP	Signif-icance
Body weight at :							
6 weeks	727.55	730.14	721.57	721.38	727.13	722.23	NS
	±20.41	±11.26	±14.85	±16.71	±18.53	±11.64	
14 weeks	1629.92	1752.71	1737.97	1601.71	1741.85	1726.31	**
	±31.62^{b}	±21.62^{a}	±37.51^{a}	±25.62^{b}	±19.08^{a}	±26.43^{a}	
Daily weight gain (g)	16.09	18.26	18.05	15.72	18.12	17.93	**
	±1.63^{b}	±0.56^{a}	±0.73^{a}	±0.32^{b}	±1.24^{a}	±0.42^{a}	
Daily feed consumption (g)	73.69	78.60	77.91	78.17	82.94	84.16	*
	±1.62^{c}	±0.67^{b}	±1.19^{b}	±0.95^{b}	±2.062^{ab}	±1.68^{a}	
Feed conversion	4.58	4.31	4.32	4.97	4.58	4.69	*
(kg feed/kg gain)	±0.012^{b}	±0.024^{c}	±0.009^{c}	±0.039^{a}	±0.057^{b}	±0.013^{b}	
PI (%)[1]	35.57	40.67	40.23	32.23	38.03	36.81	**
	±0.97^{bc}	±1.09^{a}	±1.37^{a}	±0.68^{c}	±0.51^{ab}	±0.82^{b}	
Total feed cost (L.E.)[2]	1.976	2.132	2.106	2.105	2.259	2.285	
Feed cost/kg gain (L.E.)	2.193	2.087	2.086	2.39	2.227	2.274	
Economical efficiency (%)[3]	287.73	307.22	310.21	255.49	281.8	273.52	**
	±9.67^{b}	±13.46^{a}	±6.48^{a}	±9.61^{d}	±10.13^{bc}	±7.15^{c}	

Means in the same row bearing different letters, differ significantly (P<0.05).
[1]PI = Performance index. [2]Total feed cost (L.E.) = Feed price/ kg (L.E.) x total feed intake (kg).
[3] Economical efficiency based on that the price of 100 kilogram of diet BCP, ABCP, UBCP, CCP, ACCP and UCCP
were 47.88, 48.43, 48.28, 48.08, 48.63 and 48.48 Egyptian pound (L.E.), respectively and the price of kg of live body
weight at salling was 8.5 L.E.
NS = not significant * P < 0.05 ** P < 0.01.

The chemical composition of the experimental diets, feces and urine were analyzed according to A.O.A.C. methods (1990). Total nitrogen in the feed, feces and urine were estimated by using micro Kjeldahl method (Chibnall *et al.* 1943). Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined by methods of Van Soest and Robertson (1980) modified by Pakistan Agricultural Council (1981), Cellulose and hemicellulose were determined by difference. The metabolizable energy (ME) values of the offered diets were collected according to the equation described by Kalogen (1985) as follows :

ME (K cal / kg) = (0.588 + 0.164 X) 239

where X is the dry matter digestion of the offered diet.

Values of the total digestible nutrients (TDN%) and the digestible crude protein (DCP%) were calculated according to classic formula (Cheeke *et al.* 1982).

At the 14th weeks of age (the marketing age) a total of twenty four rabbits (four rabbits from each group) were randomly taken and slaughtered. Rabbits were kept off feed for 16 hours before slaughter. Carcass traits described by Belasco *et al.*(1992) were evaluated. Hot carcass weight (HCW) was obtained 15 to 30 minutes after slaughter including liver, kidneys and head besides : (lungs, esophagus, thymus and heart). Cold carcass weight (CCW) was obtained after refrigerating the hot carcass at 4^{O}C for 24 hours. Drip loss percentage was calculated as :

[(HCW – CCW) / HCW] x 100

Giblets weights (liver, kidneys, heart and spleen), alimentary canal (full and empty), cecum (full and empty) and carcass measurements were obtained and their proportion to the live body weight was calculated.

The analysis of variance computed according to Steel and Torrie (1980) was conducted by using completely randomized design. The differences between means were tested by LSD procedures available within the MSTATC-C software package (VER. 1.2, 1992).

RESULTS AND DISCUSSION

Chemical analysis of untreated and ammoniated bean straw and corn stalks

Chemical analysis of untreated and ammoniated bean straw and corn stalks are given in Table (1). Urea treated bean straw and corn stalks showed the highest moisture content. The crude protein content (on DM basis) in untreated bean straw and corn stalks was 7.62 and 4.75%, respectively. These values were approximately doubled by ammoniation, reaching 13.15 and 9.31% with the anhydrous ammonia treated bean straw and corn stalks, respectively, while it was 12.81 and 9.04% with urea treated bean straw and corn stalks, respectively. Similar results were obtained by Abdel Rahman *et al.* (1989). The results indicate that roughages treated with ammonia have lower content of crude fiber than that of untreated material. The treatment of bean straw and corn stalks with anhydrous ammonia decreased crude fiber content by 9.09 and 7.93%, respectively, while the treatment with covered urea decreased the crude fiber content by 5.76 and 6.71%, respectively. These results agree with those obtained by Gupta *et al.* (1985), Benahmed and Dulphy (1985) and Gihad *et al.* (1989). Nevertheless, Horton and Steacy (1981) found that ammoniation did not affect crude fiber content of treated roughages. Table (1) shows that anhydrous ammonia treatment of bean straw and corn stalks decreased neutral

detergent fiber (NDF) by 10.02 and 11.23%, respectively, while covered urea treatment decreased the NDF by 11.82 and 10.13%, respectively. The acid detergent fiber (ADF) and acid detergent lignin (ADL) content have not been affected by ammoniation of bean straw and corn stalks. Therefore, hemicellulose of bean straw and corn stalks were consequently decreased with anhydrous ammonia by 31.02 and 37.41%, respectively, and with covered urea treated by 37.11 and 32.05%, respectively. These findings agreed with those of Streeter *et al.*(1983), Jensen (1988) and Gihad *et al.*(1989).

Growth performance and economical efficiency

Results of growth performance and economical efficiency of growing NZW rabbits fed ammoniated bean straw and corn stalks are shown in Table (4). The final body weight at 14 weeks of age of rabbits fed diets containing anhydrous ammonia or covered urea bean straw or corn stalks were significantly higher ($P<0.01$) than those fed the control diets. Furthermore, diets including anhydraous ammonia bean straw (ABCP) or corn stalks (ACCP) increased significantly ($P<0.01$) daily weight gain by 13.49 and 15.27%, respectively, while diets including covered urea bean straw (UBCP) or corn stalks (UCCP) diets increased the daily weight gain by 12.18 and 14.09%, respectively, than those fed diets including untreated bean straw (BCP) or corn stalks (CCP). These results support those found by Seed (1983) and Bielanski *et al.* (1996a). Ammoniated bean straw and corn stalks were more palatable than the unammoniated (Table 3). This more palatability was reflected on a higher ($P<0.05$) feed consumption by rabbits fed diets ABCP, UBCP, ACCPS and UCCP. Similar results were obtained by Abd El-Rahman *et al.* (1989). However, in a conflicting report, Bielanski *et al.* (1996a) reported that rabbits fattened on a diet containing ammoniated straw consumed significantly ($P<0.05$) less feed than rabbits fed untreated one.

Ammoniated bean straw and corn stalks by anhydrous ammonia or urea improved significantly ($P<0.05$) both feed conversion ratio and performance index (Table 3). The improvement in feed efficiency by ammoniation of bean straw and corn stalks may be attributed to an increase in efficiency of nutrient absorption and nutrient utilization (Fairly *et al.*, 1985).

Results of the economical evaluation of rabbits as affected by ammonia treatment of bean straw and corn stalks are presented in Table (4). Feed costs/ kg gain with diets containing ammoniated bean straw or corn stalks decreased than in control diets. The lowest feed costs/kg gain were observed in diets ABCP and UBCP. The economical efficiency values of groups fed diets ABCP, UBCP, ACCP and UCCP were increased significantly ($P<0.01$) by 6.77, 7.81, 10.30 and 7.06%, respectively, than the control groups (BCP and CCP). Similar results were obtained by Gomaa *et al.*(1989), who reported that the feed cost/kg gain was decreased by 27.75% in lambs fed on NH_3- treated rice straw.

Digestibility coefficients of nutrients, nutritive value and nitrogen utilization

The digestion coefficient of nutrients and nutritive value of the experimental diets are shown in Table (5). Mixed diets containing ammoniated bean straw and corn stalks were not only palatable, but also more nutritious than those

Table 5. Effect of feeding mixed diets containing ammoniated and urea treated bean straw and corn stalks on digestibility coefficients and nutritive value with growing NZW rabbits.

Items	Experimental groups						
	BCP	ABCP	UBCP	CCP	ACCP	UCCP	Significance
Digestibility coefficients							
Dry matter (DM)	63.10±2.91^{c}	68.59±0.54^{b}	68.97±1.37^{b}	65.23±0.81^{c}	71.15±0.62^{ab}	72.05±0.79^{a}	*
Organic matter (OM)	59.35±1.03^{c}	64.19±0.72^{b}	64.25±2.16^{b}	59.85±1.51^{c}	62.15±0.19^{a}	65.49±0.94^{a}	*
Crude protein (CP)	68.83±1.23^{c}	77.53±1.26^{a}	76.42±1.37^{a}	65.43±0.62^{d}	74.87±0.74^{ab}	72.06±0.36^{b}	**
Ether extract (EE)	76.81±0.86^{d}	80.11±0.37^{b}	79.34±1.48^{bc}	78.45±0.23^{c}	81.42±0.94^{a}	81.65±1.08^{a}	*
Crude fiber EE (CF)	14.36±0.043^{d}	23.75±0.096^{b}	21.34±0.015^{c}	16.01±0.037^{d}	24.81±0.035^{a}	23.67±0.061^{b}	**
Nitrogen free ext. (NFE)	6.43±0.67^{c}	68.59±0.96^{bc}	69.92±1.03^{b}	67.28±0.82^{c}	70.51±1.03^{b}	72.08±1.58^{a}	*
NDF	57.15±0.97^{c}	64.51±1.37^{b}	63.08±2.14^{b}	54.68±2.29^{c}	66.71±0.51^{a}	63.97±1.08^{b}	**
ADF	49.71±0.82^{c}	56.61±1.08^{a}	57.05±1.73^{a}	46.68±1.25^{d}	52.83±0.37^{b}	53.52±1.06^{b}	**
ADL	2.07±0.03^{c}	6.88±0.12^{b}	8.95±0.06^{ab}	2.26±0.03^{c}	7.51±0.09^{b}	9.47±0.17^{a}	**
Nutritive value :							
TDN	56.86±1.68^{d}	61.25±0.91^{b}	61.19±1.64^{b}	58.33±2.86^{c}	63.31±1.07^{a}	63.64±2.06^{a}	**
DCP	10.38±0.06^{c}	12.91±0.04^{a}	12.66±0.13^{a}	9.97±0.14^{c}	12.47±0.26^{ab}	11.82±0.38^{b}	*
ME (kcal/kg feed DM)	2616.8±7.16^{d}	2828.9±10.3^{c}	2843.9±6.33^{bc}	2697.3±9.01^{d}	2929.3±3.69^{ab}	2964.6±7.01^{a}	**

Means in the same row bearing different letters, differ significantly (P<0.05). NS = not significant * P < 0.05 ** P < 0.01.

Table 6. Effect of feeding mixed diets containing ammoniated bean straw and corn stalks on nitrogen utilization of growing NZW rabbits.

Items	Experimental groups						
	BCP	ABCP	UBCP	CCP	ACCP	UCCP	Significance
Nitrogen utilization :							
N-intake (g/day)	1.778±0.011^{d}	2.094±0.043^{bc}	2.064±0.032^{b}	1.905±0.019^{c}	2.209±0.025^{a}	2.230±0.021^{a}	**
Fecal-N (g/day)	0.554±0.0072^{b}	0.471±0.0048^{c}	0.487±0.0076^{c}	0.659±0.0015^{a}	0.555±0.013^{b}	0.623±0.011^{a}	*
Urinary-N (g/day)	0.57±0.016^{d}	0.802±0.064^{b}	0.758±0.017^{bc}	0.638±0.024^{c}	0.933±0.059^{a}	0.864±0.013^{ab}	**
N-ABCPorbed (g/day)	1.224±0.041^{c}	1.623±0.027^{ab}	1.577±0.054^{b}	1.246±0.019^{c}	1.654±0.052^{a}	1.607±0.073^{b}	*
N-balance (g/day)	0.654±0.008^{c}	0.821±0.027^{a}	0.814±0.032^{a}	0.608±0.014^{c}	0.721±0.019^{b}	0.743±0.011^{b}	*
N-balance (g/day) % of N-intake	36.78±0.421^{b}	39.21±0.315^{a}	39.68±0.266^{a}	31.92±0.179^{d}	32.64±0.362^{c}	33.32±0.096^{c}	**

Means in the same row bearing different letters, differ significantly (P<0.05). NS = not significant * P < 0.05 ** P < 0.01.

Table 7. Effect of feeding mixed diets containing ammoniated bean straw and corn stalks on carcass trails of growing NZW rabbits.

Items	Experimental groups						
	BCP	ABCP	UBCP	CCP	ACCP	UCCP	Significance
Preslaughter weight (g)	1665.4±10.23	1748.9±28.66	1725.3±18.67	1642.8±15.51	1738.2±28.97	1709.7±20.03	---
Hot carcass weight, g	909.8±15.61^{c}	1019.1±11.15^{a}	999.5±19.79^{ab}	907.3±27.61^{c}	1002.6±14.56^{a}	995.6±18.76^{b}	*
Dressing (%)	54.63±2.15^{b}	58.27±1.67^{b}	57.93±1.01^{a}	55.23±2.55^{b}	57.68±1.21^{a}	58.23±0.38^{a}	*
Cold carcass weight, g	882.6±19.65^{c}	991.7±29.61^{a}	970.8±17.61^{ab}	883.8±13.28^{c}	974.3±10.19^{a}	969.7±14.72^{a}	*
Carcass drip loss (%)	1.632±0.028	1.567±0.011	1.663±0.042	1.428±0.037	1.631±0.032	1.514±0.019	NS
Fur (%)	15.37±0.37	14.51±0.28	15.24±0.41	14.86±0.11	15.71±0.22	15.08±0.32	NS
Total giblets weight (%)	4.35±0.024	4.51±0.062	4.48±0.015	4.28±0.013	4.37±0.028	4.49±0.012	NS
Liver (%)	2.82±0.015	2.70±0.042	2.98±0.037	2.78±0.025	2.67±0.032	2.77±0.019	NS
Heart (%)	0.59±0.009	0.67±0.013	0.63±0.011	0.57±0.017	0.71±0.021	0.74±0.015	NS
Kidneys (%)	0.87±0.032	1.05±0.028	0.81±0.046	0.85±0.051	0.88±0.018	0.89±0.038	NS
Spleen (%)	0.07±0.008	0.09±0.012	006±0.005	0.08±0.008	0.11±0.007	0.09±0.014	NS
Abdominal fat (%)	0.72±0.041	1.05±0.081	0.97±0.064	0.87±0.029	0.98±0.035	0.92±0.062	NS
Alimentary canal							
Full	9.84±0.28	9.23±0.19	9.48±0.37	9.79±0.07	9.53±0.22	9.46±0.15	NS
Empty	3.74±0.045	3.42±0.021	3.58±0.036	3.68±0.019	3.53±0.032	3.47±0.015	NS
Cecum (%)							
Full	3.71±0.12	3.45±0.091	3.51±0.28	3.84±0.37	3.36±0.094	3.45±0.18	NS
Empty	0.65±0.053	0.61±0.021	0.59±0.017	0.69±0.03	0.63±0.07	0.64±0.064	NS

Means in the same row bearing different letters, differ significantly (P<0.05). NS = not significant * P < 0.05 ** P < 0.01.

unammoniated. All digestibility coefficients increased significantly ($P<0.05$ or 0.01) in groups fed diets containing ammoniated roughages. Dry matter digestibility was increased significantly ($P<0.01$) by 8.7 and 9.3% in diets ABCP and UBCP, respectively, and by 9.08 and 10.46% in diets ACCP and UCCP, respectively, than control groups BCP and CCP. Also, groups fed diets BCP and CCP showed the lowest crude protein digestibility values among the experimental groups with 68.83 and 65.43%, respectively, where as groups fed diets ABCP, UBCP, ACCP and UCCP showed 77.53, 76.42, 74.87 and 72.06%, respectively, as crude protein digestibility values. The improvement of protein digestibility in groups fed diets containing ammoniated roughages may be due to the fixation of little amount of ammonia on the treated roughages, which increase crude protein content in these groups between 1.2-1.6% than the control group (Table 3) which lead to better utilization of nitrogen by cecal microorganisms. Singh *et al.* (1990) and Al-Bar and Al-Aghbari (1996) reported that urea addition up to 1% in the rabbit's diet had a favorable effect when used with a low protein diet which seem to improve cecal microbial activity and increase VFA's production. Crude fiber digestibility of groups fed diets ABCP and UBCP were increased significantly ($P<0.01$) by 9.4 and 6.98 units, respectively, more than the group fed diet CCP. There results are in agreement with those observed by Gihad, *et al.*(1989) and Gomma, *et al.*(1989). The NDF, ADF and ADL digestibilities in groups fed diets containing bean straw or corn stalks ammoniated by anhydrous ammonia or urea were significantly ($P<0.01$) higher than those fed diets containing untreated roughages. Better digestibilities in diets containing ammoniated bean straw or corn stalks was reflected on improving its nutritive value expressed as total digestible nutrients (TDN), digestible crude protein (DCP) and metabolizable energy (ME) as shown in Table (5).

The data of nitrogen utilization are summarized in Table (6). The groups fed diets BCP and CCP provided the lowest ($P<0.01$) nitrogen intake. High nitrogen content of diets containing ammoniated bean straw corn stalks in addition to their high intake by rabbits indicated high N-intake, N-absorbed and N-balance for the control diets. Moreover, N-balance % of N-intake was increased significantly ($P<0.01$) by 6.61 and 7.89 and by groups fed diets ABC and UBCP, respectively than group fed BCP and by 2.26 and 4.39% in groups fed diets ACCP and UCCP, respectively, than group fed CCP. These results are in agreement with those found by Benahmed and Dulphy (1985) and Gihad *et al.*(1989).

Carcass characteristics

The results of carcass traits are presented in Table (7). Results showed that carcass traits as hot carcass weight, cold carcass weight and dressing % were increased significantly ($P<0.05$) in mixed diets containing ammoniated bean straw or corn stalks. Hot carcass weight in groups fed diet ABCP and UBCP were increased by 12.01 and 9.86% respectively than group fed diet BCP, while groups fed diet ACCP and UCCP by 10.5 and 9.73%, respectively than group fed diet CCP. In general, total giblets weight insignificantly increased in groups fed diets containing ammoniated bean straw or corn stalks. Similar results were obtained by Bielanski *et al.* (1996a). However, the weight of alimentary tract and cecum were insignificantly higher in rabbits fed diets containing

unammoniated bean straw or corn stalks (BCP or CCP).

From the previous results it could be concluded that the use of pelleted mixed diets containing ammoniated bean straw or corn stalks improved growth performance, feeding values and economical efficiency of growing rabbits. Also, the results of the two ammoniation procedures (anhydrous ammonia and covered urea) showed comparable results.

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تأثير تغذية الأرانب النامية علي العلائق المكعبة المحتوية علي مواد علف مالئة فقيرة معاملة بالأمونيا

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تمت معاملة كلا من تبن الفول وحطب الذرة بالأمونيا عن طريق استخدام ٣% أمونيا لامائية أو ٥% محلول يوريا (لتر/كجم) كمصدر لتكوين أمونيا، وذلك لتحسين معاملات هضم واستساغة تلك المواد في عليقة الأرانب النامية. تم تقسيم أثنين وسبعون من ذكور الأرانب النامية بمتوسط عمر ٦ أسابيع، تم تقسيمها إلي ستة مجاميع متماثلة متوسط الوزن لها ٧٢٥ ± ٢,٧ جم وذلك لاستخدامها في تجارب غذائية بهدف دراسة كفاءة هذه الحيوانات عند تغذيتها علي علائق محتوية جزئيا علي ٢٨% تبن الفول أو ٣١% حطب الذرة الغير معامل أو المعامل بالأمونيا.

أوضحت النتائج إلي أن كمية الغذاء المستهلكة بواسطة الأرانب المغذاه علي العلائق المحتوية علي تبن الفول أو حطب الذرة المعامل بالأمونيا كانت أكبر من العلائق المحتوية علي تلك المواد في حالة عدم معاملتها. كما أدت التغذية علي العلائق المحتوية علي تبن الفول أو حطب الذرة المعامل بالأمونيا إلي زيادة جوهرية ($p<0.01$) في معدل الزيادة اليومية في وزن الجسم وإلي تحسين معامل التحويل والكفاءة الغذائية وذلك مقارنة بعلائق مجموعة المقارنة.

أظهرت العلائق المحتوية علي تبن الفول أو حطب الذرة المعامل بالأمونيا زيادة جوهرية ($p<0.01, 0.05$) في جميع معاملات الهضم مقارنة بالعلائق المحتوية علي تلك المواد بدون معاملة. كما أظهرت صفات الذبيحة من حيث وزن الذبيحة الساخن والبارد ونسبة التصافي % زيادة جوهرية ($p<0.05$) في الأرانب المغذاه علي علائق محتوية علي تبن فول أو حطب الذرة معامل بالأمونيا مقارنة بمجموعة المقارنة.