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Effect of non-protein nitrogen in the ration on ram semen quality

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Abstract

This study was conducted on 20 rams, 6–8 months old. Semen was collected from all rams once weekly for 8 weeks after 4 months of different feeding treatments. The results revealed an improvement in the physico-chemical characteristics of ram semen after feeding ammoniated rice straw with or without alfalfa hay compared with untreated rice straw. It was concluded that ammoniated rice straw with 3% anhydrous ammonia in the ration can be recommended for feeding growing rams without any harmful effect on semen quality. © 1998 Elsevier Science B.V.

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1. Introduction

With the encouragement of the Egyptian government of the expansion of non-traditional rations containing either urea or ammonia for farm animals, it is necessary to eliminate side effects on the reproductive capacity of these animals. A review of the literature revealed that urea does not have a harmful effect on the fertilizing capacity or lambing rate in sheep (Archibald, 1943; Ryder et al., 1972; Thompson et al., 1973). Libido and semen quality appeared normal in rams fed on purified diets containing urea (Warnick et al., 1961). Moreover, the ejaculate volume, mass motility and sperm cell concentration, as well as total proteins, urea nitrogen and nucleic acid increased significantly in whole semen of buffalo fed ammoniated rice straw (El-Khadrawy, 1991). However, the efficacy of ammoniation in improving the feeding value of roughages on sheep reproduction is a matter of research interest from an economic point of view. Thus, the present study was designed to clarify the effect of feeding ammoniated rice straw on the semen producing capacity of rams.

2. Material and methods

The present study was conducted on a total of 20 sexually immature Rhamani rams, 6–8 months old. All rams were examined clinically to ensure soundness of health in general and of genitalia. Animals were divided into five comparable groups, each of four rams, and kept in separate pens on different feeding systems. A concentration mixture was given daily, at about 2% of ram liveweight, as a basal ration for all groups. The concentrate mixture con-

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sisted of 30% yellow corn, 25% wheat bran, 10% soyabean meal, 11.5% cotton seed cake, 15% rice polish, 6% molasses, 0.1% vitamins, 0.2% minerals, 0.1% common salt, 1.1% bicarbonate and 1.0% limestone. In addition to the concentrate mixture, the ration comprised alfalfa hay (Group 1), untreated rice straw (Group 2), ammoniated rice straw with 3% anhydrous ammonia (Group 3), alfalfa hay and untreated rice straw (Group 4), alfalfa hay and ammoniated rice straw (Group 5), ad libitum.

After 3 months on the different feeding systems, all rams were allowed daily training on a male teaser for sexual stimulation and adaptation to the artificial vagina for semen collection for 4 weeks. Thereafter, first and second ejaculates of each ram were collected and physical characteristics assessed once weekly for an 8 week period. Immediately after assessment, the semen was centrifuged at 3000 rev min^{-1} for 10 min to obtain sperm-free seminal plasma. This was kept at $-20°C$ until analyzed for total proteins, albumin, globulins and urea. At the analysis, the seminal plasma was pooled so that three samples from both first and second ejaculates were taken for each ram. The data obtained were tabulated and statistically analyzed, where appropriate, according to Haber and Runyon (1979).

Table 1
Physical characteristics of ram semen in relation to effect of feeding and sequence of ejaculation

Group[a]/seq. of ej.[b]	Ejaculate volume (ml)	pH	Individual motility (%)	Sperm cell concentration ($\times 10^6$ ml^{-1})	Sperm abnormality (%)	
					Primary	Secondary
Group 1						
1st (25)	0.77 ± 0.06	6.70 ± 0.04	73.89 ± 1.54	2031.08 ± 121.58	2.08 ± 0.19	3.50 ± 0.34
2nd (24)	0.69 ± 0.06	6.75 ± 0.03	75.56 ± 0.89	2201.08 ± 116.85	2.17 ± 0.27	3.58 ± 0.53
Mean (49)	0.73 ± 0.04	6.73 ± 0.03	74.72 ± 0.88	2116.08 ± 84.35	2.13 ± 0.16	3.54 ± 0.31
Group 2						
1st (23)	0.46 ± 0.06	6.85 ± 0.04	70.50 ± 2.03	1718.33 ± 59.87	3.25 ± 0.22	6.25 ± 0.88
2nd (22)	0.38 ± 0.04	6.80 ± 0.05	71.50 ± 2.24	1821.67 ± 68.38	3.77 ± 0.41	7.17 ± 1.03
Mean (45)	0.42 ± 0.04	6.83 ± 0.03	71.00 ± 1.48	1770.00 ± 45.72	3.51 ± 0.23	6.71 ± 0.67
Group 3						
1st (30)	0.67 ± 0.08	6.62 ± 0.03	77.35 ± 1.06	2028.75 ± 91.46	3.00 ± 0.56	3.25 ± 0.45
2nd (26)	0.54 ± 0.05	6.72 ± 0.04	76.76 ± 1.13	2042.50 ± 81.94	3.17 ± 0.35	2.25 ± 0.43
Mean (56)	0.60 ± 0.05	6.67 ± 0.03	77.06 ± 0.76	2035.63 ± 60.07	3.08 ± 0.32	2.75 ± 0.32
Group 4						
1st (28)	0.75 ± 0.08	6.80 ± 0.05	72.50 ± 1.37	1978.75 ± 124.81	3.33 ± 0.56	4.17 ± 0.41
2nd (25)	0.52 ± 0.04	6.78 ± 0.05	71.43 ± 1.10	2035.00 ± 104.12	3.42 ± 0.64	4.25 ± 1.04
Mean (53)	0.60 ± 0.05	6.79 ± 0.03	72.00 ± 0.88	2006.88 ± 79.88	3.38 ± 0.41	4.21 ± 0.55
Group 5						
1st (29)	0.74 ± 0.07	6.72 ± 0.05	74.76 ± 1.35	2335.00 ± 87.11	2.42 ± 0.42	3.42 ± 0.45
2nd (28)	0.67 ± 0.06	6.74 ± 0.05	74.11 ± 1.59	2411.67 ± 73.46	2.50 ± 0.50	3.67 ± 0.41
Mean (57)	0.70 ± 0.05	6.73 ± 0.03	74.43 ± 1.04	2373.33 ± 56.29	2.71 ± 0.32	3.54 ± 0.30
Overall mean						
1st (135)	0.69 ± 0.03	6.73 ± 0.02	73.46 ± 0.68	2018.38 ± 50.09	2.92 ± 0.19	4.12 ± 0.27
2nd (125)	0.57 ± 0.03	6.76 ± 0.02	73.51 ± 0.65	2102.38 ± 46.81	2.88 ± 0.20	4.18 ± 0.39
Mean (260)	0.63 ± 0.02	6.74 ± 0.02	73.48 ± 0.47	2060.38 ± 34.35	2.90 ± 0.14	4.15 ± 0.24

[a]Group 1, alfalfa hay; Group 2, untreated rice straw; Group 3, ammoniated (3%) rice straw; Group 4, alfalfa hay + untreated rice straw; Group 5, alfalfa hay + ammoniated rice straw.
[b]Sequence of ejaculation. The numbers of ejaculations are given in parentheses.
Values are expressed as mean ± standard error.

Table 2
Analysis of variance for effects of feeding and sequence of ejaculation on ram semen

Source of variance	Feeding (F)	Sequences	F × S	Remainder
Physical characteristics	(4)	(1)	(4)	(310)
Ejaculate volume	0.327**	0.491**	0.032	0.054
pH	0.084**	0.015	0.083**	0.018
Individual motility	202.758**	0.078	11.292	30.320
Sperm concentration	1133033**	211680	870068**	78420
Primary abnormalities	5.950*	0.033	0.325	2.279
Secondary abnormalities	55.492**	0.133	2.842	5.344
Chemical properties	(4)	(1)	(4)	(150)
Total proteins	8.179**	1.109	1.0.25*	0.366
Albumin	1.173**	0.085	0.120*	0.038
Globulin	3.210**	0.013	0.377	0.297
Urea	366.128**	0.980	4.194	36.367

Values are expressed in mean squares.
Degrees of freedom are given in parentheses.

Table 3
Concentration of some chemical constituents of ram semen plasma in relation to effect of feeding and sequence of ejaculation

Seq. of ej.[a]	Total protein (g)[b]	Albumin (g)[b]	Globulin (mg)[b]	Urea (mg)[b]
Group 1				
1st (12)	3.56 ± 0.23	1.20 ± 0.07	1.96 ± 0.48	32.75 ± 3.67
2nd (12)	2.13 ± 0.14	0.94 ± 0.12	1.29 ± 0.25	33.66 ± 1.84
Mean (24)	2.84 ± 0.27	1.07 ± 0.08	1.63 ± 0.25	32.91 ± 2.74
Group 2				
1st (12)	1.72 ± 0.08	0.37 ± 0.10	0.92 ± 0.20	24.08 ± 3.87
2nd (12)	1.51 ± 0.02	0.32 ± 0.07	1.19 ± 0.08	22.02 ± 2.16
Mean (24)	1.61 ± 0.05	0.34 ± 0.06	1.06 ± 0.11	23.05 ± 1.94
Group 3				
1st (12)	3.67 ± 0.28	0.93 ± 0.09	2.20 ± 0.21	37.29 ± 3.33
2nd (12)	3.75 ± 0.26	1.11 ± 0.02	2.08 ± 0.22	38.69 ± 2.19
Mean (24)	3.71 ± 0.18	1.02 ± 0.05	2.14 ± 0.14	37.99 ± 1.89
Group 4				
1st (12)	3.11 ± 0.34	0.84 ± 0.12	1.72 ± 0.27	37.03 ± 3.32
2nd (12)	3.14 ± 0.51	0.90 ± 0.03	1.94 ± 0.10	36.86 ± 1.97
Mean (24)	3.12 ± 0.29	0.87 ± 0.06	1.83 ± 0.14	36.95 ± 1.82
Group 5				
1st (12)	4.04 ± 0.20	1.42 ± 0.06	2.50 ± 0.31	36.18 ± 2.84
2nd (12)	3.75 ± 0.22	1.07 ± 0.11	2.65 ± 0.21	35.30 ± 0.83
Mean (24)	3.90 ± 0.15	1.24 ± 0.08	2.57 ± 0.18	35.74 ± 1.40
Overall				
1st (60)	3.22 ± 0.20	0.95 ± 0.08	1.86 ± 0.17	33.47 ± 1.73
2nd (60)	2.86 ± 0.22	0.87 ± 0.07	1.83 ± 0.13	33.19 ± 1.38
Mean (120)	3.04 ± 0.15	0.91 ± 0.05	1.85 ± 0.10	33.33 ± 1.09

[a]Sequence of ejaculation. The numbers of ejaculations are given in parentheses.
[b]Per 100 ml seminal plasma.
Values are expressed as mean ± standard error.

3. Results

Rams fed on ammoniated rice straw (Group 3) (Table 1) had higher ejaculate volume (0.60 ± 0.05 ml), sperm motility ($77.06 \pm 0.76\%$) and sperm concentration ($2035.63 \pm 60.07 \times 10^6$ ml^{-1}), as well as lower pH (6.67 ± 0.03) and a lower incidence of sperm abnormalities of primary (3.08 ± 0.32) and secondary ($2.75 \pm 0.32\%$) origin than those maintained on untreated rice straw (Group 2). Moreover, rams fed on ammoniated rice straw with alfalfa hay (Group 5) had higher ejaculate volume (0.70 ± 0.05 ml), sperm motility ($74.43 \pm 1.04\%$), sperm concentration ($2373.33 \pm 56.29 \times 10^6$ ml^{-1}), and fewer primary ($2.71 \pm 0.32\%$) and secondary ($3.54 \pm 0.30\%$) sperm abnormalities than those fed on untreated rice straw with alfalfa hay (Group 4).

Analysis of variance (Table 2) revealed a difference ($P < 0.05$) in the incidence of primary abnormalities and differences ($P < 0.01$) in other physical characteristics of semen between different feeding groups as well as in ejaculate volume between the first (0.69 ± 0.03 ml) and second (0.57 ± 0.03 ml) ejaculation. There was an interaction ($P < 0.1$) between feeding and ejaculation in their effects on pH and sperm concentration (Table 2).

There was a difference ($P < 0.01$) in the chemical estimates of ram seminal plasma (Tables 2 and 3) between the different feeding groups. The lowest total proteins (1.61 ± 0.05 g/100 ml seminal plasma), albumin (0.34 ± 0.06 g/100 ml seminal plasma), globulin (1.06 ± 11 g/100 ml seminal plasma) and urea (23.05 ± 1.94 mg/100 ml seminal plasma) were estimated in the seminal plasma of rams fed on untreated rice straw (Group 2) compared with the other feeding groups. There was a interaction ($P < 0.05$) between feeding and ejaculation in their effects on total proteins and albumin (Table 2).

4. Discussion

Ammoniation of rice straw, for raising crude protein and total digestible nutrients of the ration, has been used safely in improving the productive and reproductive performance of livestock (Jayasuriya and Perera, 1982; Birkelo et al., 1985; Abd El-Aziz, 1986; Ibrahim, 1988). There was an increase ($P < 0.01$) in semen volume for rams fed on the concentrate mixture with ammoniated rice straw and/or alfalfa hay compared with those fed on the concentrate mixture with untreated rice straw. Such an increase might be due to ammoniation raising the digestible crude protein in the ration (El-Mounier, 1990; Khadr, 1995). When the protein intake increases, an increase in the level of gonadotrophins (FSH and ICSH), which are protein-based (Cole and Cupps, 1977; Hafez, 1980) can be expected. Such an increase in gonadotrophins (mainly ICSH, LH) is followed by an increase in the level of testosterone (Coulter, 1986). Testosterone activates the secretory function of the accessory glands (Salisbury et al., 1978) which, in turn, increases seminal volume, as shown in the present study. Also, an improvement in sperm cell concentration in rams fed ammoniated rice straw compared with those fed untreated rice straw might be anticipated. This finding is in agreement with previous studies in which ram diets were supplemented with ammoniated rice straw (El-Khadrawy, 1991) or urea (Warnick et al., 1961; Thompson et al., 1973). However, the pH of ram semen for all feeding groups in the present study seemed to be within the normal range, (Mann, 1964; Mohamed, 1978; Hafez, 1980). However, there was an increase ($P < 0.01$) in semen pH in rams fed on untreated rice straw in comparison with those fed on ammoniated rice straw—a finding which is in agreement with the report by El-Khadrawy (1991). This increase in pH might be attributed mainly to the decrease ($P < 0.1$) in sperm cell concentration and sperm motility due to feeding untreated rice straw. El-Chahida et al. (1977) indicated that there is a significant negative correlation between pH and sperm cell concentration and sperm motility. The physical parameters of semen seemed to be best after feeding ammoniated rice straw with or without alfalfa hay. When rams were fed ammoniated rice straw, there was a decrease ($P < 0.01$) in sperm abnormalities, particularly of secondary origin, during their passage through the excurrent system (Hafez, 1980). Suitability of ammoniated rice straw in addition to the concentration mixture with or without alfalfa hay as a balanced ration for feeding rams might be suggested.

The present study showed higher ($P < 0.01$) contents of total proteins, albumin, globulins and urea in

the seminal plasma after feeding rams the ammoniated rice straw and/or alfalfa hay than untreated rice straw. This finding suggested improvement of the digestible crude protein by using ammoniated rice straw in the ration (Abd El-Aziz, 1986; El-Mounier, 1990; Khadr, 1995). Improvement of the seminal plasma proteins, may be helpful in regulating the osmolality changes and buffering capacity of the seminal plasma which control the metabolic activity of spermatozoa (Dietz and Flipse, 1969). There was an increase in the level of urea, under the effect of ammoniation, either in the blood (Khadr, 1995) or in the seminal plasma in the present study. Such increase might suggest contribution of the genital organs to an excretory function in body metabolism.

It can be concluded that ammoniated rice straw (3% anydrous ammonia) can be used with concentrate mixture in feeding growing rams without any harmful effect on their semen producing capacity.

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