Vet. Med. J., Giza, 39, No. 1, 157-167 (1991)

SERUM AND SEMINAL THYROID HORMONES IN RELATION TO SEMEN QUALITY OF FRIESIAN BULLS

BY

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(Received: 27.1.1991)

INTRODUCTION

T_4 and T_3 are iodoamino acid hormones produced by the thyroid gland. The biological halflife ($t_{1/2}$) of T_4 is 4-5 times that of T_3 as well as T_3 binds to the receptor of target cells with 10 times as the affinity of T_4 (Schimmel and Utiger, 1977 and Martin et al., 1985). Moreover, the majority of circulating T_3 arises by the peripheral monodeiodnation of T_4 in the liver and kidneys (Sterling et al., 1977).

In farm and laboratory animals, hypothyroidism or thyroidectomy resulted in degeneration of the testis, arrest of spermatogenesis as well as depression of spontaneous activity, motility, viability and increased abnormality of spermatozoa (Swanson and Boatman, 1953, Bruni et al., 1975 and Ghorieb et al., 1978). On the other hand, thyroid therapy was suggested to improve reproductive performance of the male animals (El-Azab et al., 1974).

The metabolic energy required for survival and motility of spermatozoa is mostly gained from seminal fructose through fructolysis. Moreover, an intimate relationship was found between fructolytic rate and spermatozoal density and motility in bull semen (Mann and Lutwak-Mann, 1981).

Available literature concerning existance and content of T_4 and T_3 in semen of bulls are scarce. Therefore, this study was planned to determine levels of serum and seminal T_4 and T_4 as well as their relation with semen quality.

MATERIALS AND METHODS

Sixteen mature, healthy, fertile Friesian bulls subjected for artificial insemination puropse in Beni Suef Centre for Artificial insemination were used. The age of bulls ranged from 3-5 years and their mean body weight was 500-600 kg. All bulls were under veterinary supervision and tested periodically against tuberculosis, brucellosis trichomoniasis and vibriosis. They were fed on barseem (30 kg/bull daily) and a concentrated ration (6 kg/bull daily) composed of 65% cotton seed cake, 20% wheat bran, 12% rice polish, 2% lime salt and 1% common salt. For this study, periodical semen samples were collected from these bulls by using artificial vagina according to Walton technique (1945) for 4 successive weeks to evaluate their semen quality (sperm density, motility %, live % and abnormalities %). Accordingly, bulls were divided into 2 groups; the first (10 bulls) was of high semen quality, while the second (6 bulls) was of moderate quality. Furthermore, individual semen samples were collected from both groups and represented the first and second ejaculates. As soon as semen sample was obtained, it was divided into 3 parts; the first was used for evaluation of

semen characters (Salisbury and Van-Demark (1961). The second part was centrifuged directly at 3000 rpm for 20 minutes in order to separate seminal plasma which was kept at -20°C till estimation of T_4 and T_3 contents by I^{125} radioimmunoassay according to Abraham (1981). T_4 and T_3 radioimmunoassay kits were supplied by ICN Biochemical Inc, Diagnostic Division. The third seminal part was used to determine fructose concentration at zero time as well as after 1, 2 and 3 hours incubation at 37°C and the fructolysis index was calculated according to Mann (1948). In the same time, individual blood samples were collected from these bulls early in the morning. The sera were separated and preserved at -20°C till radioimmunoassay of T_4 and T_3 as performed for seminal plasma.

Statistical analysis of the obtained data and correlation factor "r" were carried out according to Snedecor and Cochran (1967).

RESULTS

As demonstrated in **Table (1)**, bulls of high semen quality showed a significantly higher ($P < 0.01$) sperm concentration, motility % and live % as well as lower abnormalities % (1 st ejaculate) than their corresponding values of bulls with moderate semen quality.

Data of **Table (2)**, clarified that serum T_4 and T_3 levels were significantly higher ($P < 0.02$) in bulls of group I than those of group II. Aslo, T_3 contents in the seminal plasma of bulls in group I were higher than their corresponding values in bulls of group II. Within each group, T_3 content was higher in the 1 st ejaculate than that of the 2 nd one. On the contrary, T_4 seminal levels of bulls in group I were lower than

Table 1 : Semen characteristics of Friesian bulls with high and moderate semen quality.

Groups	Sperm cell concentration (X 10^9)	Motility %	Live %	Abnormalities %
I. Bulls of high semen quality				
1 st ejaculate	1.06 ± 0.04^a	83.41 ± 1.36^a	85.37 ± 3.25^a	8.47 ± 0.83^a
2 nd ejaculate	1.03 ± 0.05^b	84.22 ± 1.23^b	84.98 ± 2.94^b	10.32 ± 0.75
II. Bulls of moderate semen quality				
1 st ejaculate	0.82 ± 0.03^a	60.97 ± 1.13^a	73.64 ± 2.01^a	13.48 ± 1.43^a
2 nd ejaculate	0.73 ± 0.04^b	63.97 ± 1.54^b	72.96 ± 2.45^b	11.21 ± 0.97

In the same column, values having the same letters differ significantly at $P < 0.01$.

Table 2 : Serum and seminal T_4 and T_3 concentrations as well as fructolysis index in Friesian bulls.

Groups	Serum			Semen				
	T_4 (ug %)	T_3 (ng %)	T_4/T_3 ratio	T_4 (ug %)	T_3 (ng %)	T_4/T_3 ratio	Fructose concentration at zero time (mg %)	Fructolysis index (mg/10^9 sperm/hour at 37°C)
I. Bulls of high semen quality	15.81± 0.28[a]	380.72± 5.99[a]	41.53					
1 st ejaculate				0.85± 0.02[a]	276.95± 5.48[a]	3.07	261.35± 10.38[a]	1.10± 0.07[a]
2 nd ejaculate				1.34± 0.08[a]	166.38± 8.65[a]	8.05	426.10± 17.67[abc]	1.49± 0.09[a]
II. Bulls of moderate semen quality	14.07± 0.41[a]	328.27± 4.70[a]	42.86					
1 st ejaculate				13.24± 0.54[a]	257.34± 4.48[a]	51.45	245.15± 14.76[b]	0.70± 0.04[a]
2 nd ejaculate				16.05± 0.37[a]	125.67± 5.35[a]	127.71	262.60± 10.97[c]	0.93± 0.03[a]

In the same column, values have the same letters differ significantly at $P < 0.02$.

those of group II. The 1st ejaculate, within each group, contained significantly lower values of T_4 than the 2 nd ejaculate. The fructolysis index of the first group was greater than that of the second group. Then within each group, the 2 nd ejaculate had a higher index than that of the 1st ejaculate.

DISCUSSION

Tables 1 and 2 revealed that bulls with high semen quality (group I) possessed higher serum T_4 and T_3 levels than those having moderate quality (group II). This finding indicates the intimate relationship between serum T_4 and T_3 levels and male reproduction and supports previous studies of Goswami (1964); Soliman et al. (1978) and Soliman and El-Toukhy (1980) who reported that administration of thyroid hormones increased the activity of spermatogenesis and spermiogenesis. In this respect, the influence of thyroid hormones could be attributed to their effect upon synthesis, release and turnover of pituitary gonadotropic hormones (Bruni et al., 1975; Soliman et al., 1978 and El-Toukhy et al., 1982).

Previous studies regarding presence of T_4 and/or T_3 in semen and their interaction with semen quality are scarce and do not give a meaningful conclusion. The present findings showed that sperm density was directly proportional with seminal T_3 content (r = 0.943)and inversely related with seminal T_4 (r = -0.913).Thus, semen samples with the highest sperm count (group I, 1st ejaculate) contained the highest T_3 and the lowest T_4 contents. This could be explained by the findings of Schimmel and Utiger (1977) and Sterling et al. (1977) who reported that 65-75% of the metabolic effect of thyroid hormones is due to T_3; also 33-40% of circulating T_4 is monodeiodinated into T_3. Moreover, Armstorous et al. (1982)

reported that intravenous injection of T_4 into bulls resulted in an increased seminal T_4 and T_3 contents after 2 hours.

The present data cleared out that serum T_4/T_3 ratio was nearly similar in both groups (I and II). On the other hand, seminal T_4/T_3 ration exhibited exaggerated higher values in gorup II than in group I. Also, a reverse relationship was found between semen quality and seminal T_4/T_3 ratio. This observation motivated the hypothesis that inhibited conversion of T_4 into T_3 leads to accumulation of T_4 in semen and creates an imbalance in T_4/T_3 ratio which may be responsible for decreased seminal quality of bulls in group II. Therefore, it is advisable to include determination of seminal T_4/T_3 ratio during the judgement of semen quality in bulls.

Concerning fructolysis index, Table, 2 showed that in group I it was sugnificantly higher ($P < 0.02$) than that of group II. Besides, the index was inversely related with seminal T_4/T_3 ratio in both groups. The observed increase of fructolysis index in the 2nd ejaculate than the 1st, in each group, may be attributed to the higher concentration of fructose at zero time in these ejaculates. Amir et al al. (1965) reported that there was a highly positive correlation among fructolysis, semen quality and initial fructose concentration.

In this study, the obtained low T_4/T_3 ratio in bulls with high semen quality reflects the importance of existance of metabolically active T_3 hormone in semen. This hormone may play an important role in energy production through fructolysis. Martin et al.(1985) reported that thyroid hormones increase the cyclic adenosine monophosphate (cAMP) concentration through enhancing the synthesis of adenylate cyclase. Moreover, Casillas and Hoskins (1970 and 1971) reported

that cAMP synthesising system in mammalian spermatozoa is insensitive to a wide variety of hormones except 3, $\bar{3}$, $\bar{5}$ triiodo-L-thyronine (T_3) which speaded up the synthesis of cAMP. Mann and Lutwak-Mann (1981) reported that generation of cAMP from ATP by adenylate cyclase has a stimulatory action on motility of spermatozoa. This motility includes the passage of spermatozoa from caput to cauda epididymidis, motility at ejaculation time and motility in the female genital tract during capacitation.

Thus, it is essential for bulls, especially those used for reproductive purposes, to feed on a ration containes balanced amounts of building stones of thyroid hormones, besides periodical evaluation of serum and seminal T_4/T_3 ratio to avoid disturabnces in thyroid hormones level which is considered one of the factors leading to subfertility in bulls.

SUMMARY

Serum and seminal levels of thyroxine (T_4) and triiodothyronine (T_3) were evaluated and correlated with the semen quality of two groups of Friesian bulls. The first group (I) was of high semen quality while the second (II) represented bulls of moderate quality. Obtained data clarified that serum T_4 and T_3 levels were significantly higher in bulls of group I than those of group II. Serum T_4/T_3 ratio was nearly similar in both groups. Seminal plasma T_3 contents of group I were higher than their corresponding values of group II, while T_4 concentrations of the second group were sharply greater than those of the first group. It was concluded that a reverse relationship is found between seminal T_4/T_3 ratio and semen quality. T_3 has the upper hand in regulating semen activity. Decreased conversion of T_4

into T_3 in semen leads to an imbalance among both hormones which could be considered as a factor responsible for inhibited sperm activity.

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ACKNOWLEDGEMENT

Thanks are to Dr. Ahmed Hasan, Director of Artificial Insemination Center, Beni Suef, for all facilities supplied during collection of samples.