A STUDY OF THE EFFECT OF VITAMIN A SUPPLEMENTATION ON SOME ASPECTS OF SHEEP PRODUCTION IN THE COASTAL DESERT

———o———

BY

Abd El Monem Omara Sooud

(B.Sc. Agric., 1965)

Thesis

Submitted to the Faculty of Agriculture, Ain-Shams University in Partial Fulfilment of the Requirements for the Degree of

MASTER OF SCIENCE

in

Animal Nutrition

Ain-Shams University

Faculty of Agriculture

1 9 7 2

APPROVAL SHEET

This thesis is approved by :

M. A. Raafat

A. Shehata

[illegible]

Date : 1 / 7 / 1972

بسم الله الرحمن الرحيم

ACKNOWLEDGEMENT

The author wishes to express his sincere gratitude to Prof. O. Shehata of the Animal Prod. Dept., Faculty of Agriculture, Ain-Shams University, for kind supervision and valuable help in reading this work.

I am sincerely grateful to Dr. A. A. Younis of the Desert Institute for furnishing the plan of this study, supervision and critical reading of the manuscript.

Sincerest appreciation is also due to Assistant Prof. M. A. El-Ashry of the Animal Prod. Dept., Faculty of Agriculture, Ain-Shams University, for supervision and valuable criticism and reading this work.
Thanks also are due to Dr. E.S.E. Galal for his valuable help on the statistical aspects.

My deepest thanks to Prof. Y.S. Ghanem, Head of the Animal Research Dept., Desert Institute for making the facilities of the Dept. available and for continuous help and encouragement
I gained greatly from valuable discussions with Assistant Prof. A.R. Abou Akkada of the Animal Prod. Dept. Faculty of Agriculture Alexandria University and Dr. S. Osman of the Biochem. Dept., Faculty of Agriculture, Cairo University for their great help in the standard curve of vitamin A and scientific discussions

Thanks are due to Mrs. M. Misbah, M. K. Elsayed, B. Sebeta and the assistant workers of Desert Institute for their help in the practical work.

Deepest thanks are also extended to the author's father and brother for their sacrifices and help.

TABLE OF CONTENTS

I. INTRODUCTION

The effective role of vitamin A in reproduction in sheep has been investigated by many workers (Peirce, 1954; Guilbert et al, 1937; and Hart and Miller, 1937). There is enough evidence that, lack of vitamin A in the diet of the pregnant ewe, provided that its vitamin A stores are depleted, results in the production of weak, dead or malformed lambs.

There is almost half a million sheep in the western coastal desert in Egypt. Under such desert condition the natural grazing season is usually limited and extends from late December up to early April and depends on the amount of rainfall which varies greatly from one year to another. In some years there is practically no grazing season. Thus, during most part of the year, sheep are fed on dried vegetations and concentrates plus hay and straw. Such feeding stuffs are considered to be deficient in provitamin A, the carotene.

At Ras El-Hekma Experimental Station located in the western Coastal zone and belongs to the Desert Institute, a flock of sheep is maintained. Field observations have indicated symptoms of vitamin A deficiency in both ewes and lambs.

A preliminary study on the same flock by Ghanem (1963 and 1967) has shown improved fertility by vitamin A supplementation to ewes during the breading and pregnancy periods. Shaaban (1970) studied the general fertility of the flock and reported a conception rate of 77.4% over a five-year period, which is rather low.

This low fertility joined with field observations in which vitamin A deficiency symptoms were developed on some individuals stimulated the interest of further study. The main objective of the present work is the investigation of the effect of vitamin A supplementation in ewes during breeding season, pregnancy and lactation on the general fertility.

II. REVIEW OF LITERATURE

1. Vitamin A Requirements.

Requirements of vitamin A are given in the literature in terms of vitamin A or of its major precursor β-carotene. Although the relation of the biological efficiency of the two compounds is not constant (ARC, 1965), experimental evidence has led to equalize each five μg. β-carotene (carotene available in natural feeds) to one ug. vitamin A alcohol in so far as its biological value is concerned. Minimum requirements are not considered to be the level which prevent the development of deficiency symptoms, as night blindness, but also to maintain liver stores of the vitamin at the lowest or critical level (ARC, 1965). Rubin and Ritter (1954) reported that many factors have been demonstrated to influence vitamin A requirements. These include dietary levels of tocopherol, types of fats and proteins fed, antibiotics, vitamin B_{12}, and stress factors such as cold or thyroxine dosage.

Briggs (1968) reported that sheep vitamin A requirements under drought feeding conditions have not been clearly defined.

Deficiency symptoms were observed in ewes grazing dry range

(Hart and Guilbert, 1933). Subsequently, Guilbert et al, (1937), suggested that the minimum carotene requirements of sheep, cattle and swine are similar and ranges from 25-39 µg per Kg. body weight daily. This level was enough for the prevention of night blindness but it did not allow for storage, reprduction or other special demands by the body. Vitamin A requirements appear to be directly related to livebody weight (Guilbert and Hart, 1935). Hart (1940) and Guilbert and Loosli (1951) agree that vitamin A requirements are proportional to the livebody weight, and not to energy expenditure of animals of different sizes.

The recommended carotene allowances given by the NRC (1949) were approximately 100 µg. per Kg. livebody weight daily for moderate storage and to meet the demands for reproduction and lactation. In terms of vitamin A, the minimum allowances given for growth were approximately 1,000 IU. per 100 lbs. of livebody weight; while for storage and reproduction they were 3,000-4,200 IU. per 100 lbs of livebody weight daily. Davis and Madsen (1941) reported that daily intakes of 30-45 µg. of carotene per Kg. of livebody weight were insufficient to allow cows to produce healthy calves. While doses of 60 µg. per Kg. were adequate. Guilbert et al. (1940) found that daily intake of vitamin A per Kg. of livebody weight required to prevent night blindness in sheep, cattle and swine to be 4.3-8.4 µg. or 17-27 IU; and that of carotene to be 25-39 µg. or 42-65 IU. These minimum levels provided only for normal growth and general well being but permitted little or no storage, and are not adequate for reproduction. Cows on the levels suggested were able to produce live youngs at full term, but the calves were weak and soon died. Three to four times the minimum vitamin A and carotene levels i.e., 3-4 x 17 IU. vit. A or 3-4 x 25 ug. carotene, when given in the last month of pregnancy, resulted in the birth of normal calves and the mothers supplied sufficient vitamin in the milk for normal growth of the calves for at least 3 months. Deficiency symptoms, however, developed in the calves within 3-4 weeks after birth, although the cows remained normal.

Intake of 3 and 5 times the minimum vitamin A and carotene levels respectively over extended period resulted in significant storage and normal repro~~t~~duction. With the aid of reserves established during the nonlactating period, enough vitamin A in the milk was available to support the young over the nursing interval. In vitamin A depleted sheep, Peirce (1945) reported that 25 ug. carotene per Kg. livebody weight arrested the fall in plasma vitamin A, but did not cure the night blindness developed already. Level of 50-55 µg. per Kg. increased blood plasma vitamin A level markedly and cured night blindness but had a little effect on liver stores. The same author concluded that reproduction in Merino ewes 3-7 years old, was satisfactory when the intake of carotene was 50 µg or more per Kg. body weight per day. He added that, successful reproduction can be obtained if the margin of safety which is frequently used in nutritional research is providing an intake of 100 µg. carotene per Kg. body weight daily.

In experiments on vitamin A depleted lambs, Myers et al, (1959) found that a level of 88 µg carotene per Kg. livebody weight daily resulted in small increases in plasma vitamin A levels. Liver stores were very low; this suggests that this level is critical. Guilbert and Loosli (1951), recommended a level of 132 µg. carotene or 68 IU. vitamin A per Kg. livebody weight for optimum growth and reproduction plus safety factor in ruminants.

Table 1 summarizes recommended carotene and / or vitamin A levels of intake for different classes of live stock with special reference to sheep. These recommendations were offered as requirements or allowances during growth, maturity reproduction or storage.

Table 1

Vitamin A and carotene requirements for sheep

Species	Purpose	Daily intake per kg livebody weight				Author
		Vitamin A		Carotene		
		µg.	I.U.	µg.	I.U.	
Sheep, cattle, and	Minimu requirements	5.6-8.4	-	25-39	-	Guilbert, et al
Swine	(to prevent night	4.3-6.4	17-27	25-39	42-65	"
"	blindness develop-	-	17-27	-	42-65	Hart, (1946)
Sheep	ment)	-	17	25	-	NRC, ([illegible])
Sheep		4.3	-	25	-	NRC, (1968)
Sheep, cattle and swine	Significant storage	13	51	125	210	Guilbert, et al
Sheep		-	67-95	100	-	NRC, (1949)
Depleted lambs	Critical for storage increased plasma vitamin A level.	-	-	88	-	Myers, et al ([illegible])
Sheep	Cured nigth blindness, increased plasma vitamin A level.	-	-	50-55	-	Peirce, ([illegible])

Species	Purpose	Daily intake per Kg. live body weight				Author
		Vitamin A		Carotene		
		ug.	I.U.	ug.	I.U.	
Sheep, cattle and swine sheep	Normal growth	4.3-6.4	17-27	25-39	42-65	Gilbert et al (1940)
		-	23	-	-	NRC, (1949)
Ruminants		-	68	132	-	Guilbert and Loosli, (1951)
Sheep		-	-	50	-	ARC, (1965)
Sheep	Replacement lambs and rams	-	26	63	-	NRC, (1961)
"	" "	-	28	63	-	NRC, (1968)
Sheep, cattle and swine	Normal reproduction and lactation	13	51	125	210	Guilbert, et al. (1940)
Sheep		-	67-95	100	-	NRC, (1949)
Ruminants	"	-	68	132	-	Guilbert and Loosli (1951)
Sheep	Satisfactory reproduction	-	-	50 or more	-	Peicre, (1954)
"	Successful reproduction	-	-	100	-	Peirce, (1954)
Sheep	Late pregnancy & lactation	-	51	125	-	NRC, (1961)
"	"	-	-	100	-	ARC, (1965)
"	"	-	50	125	-	NRC, (1968)
Sheep	Fattening lambs & early pregnancy	-	21	38	-	NRC, (1961)
"		-	-	50	-	ARC, (1965)
"	"	-	21	38	-	NRC, (1968)

2. Vitamin A and Reproduction in Female Animals.

Reproduction in mature ewes is not likely to be adversely affected by a low carotene intake unless this condition lasted for a prolonged periods (Peirce, 1954). Byers et al (1956); Hart (1940) and Peirce (1954) reported that cattle and sheep may show normal heat, ovulation and conception even though they are depleted to the point of night blindness. While, Palludan (1966) observed slightly irregular oestrus cycles in pigs. Heat symptoms were normal or mostly intensified, and the animals conceived at a normal rate in vitamin A deficiency at the point of night blindness. Yeates and Parer (1962) reviewed the effect of vitamin A - deficiency on ruminants, and reported that the activity of the ovaries, the functioning of the accessory sex organs or the oestrus cycle had a little response to vitamin A deficiency. Ewes reaching the point of night blindness may have normal conception rates. Barrett et al, (1965) studied the effect of grazing improved pasture, natural pasture and red clover pasture by Merino ewes for five years on their general fertility. The number of ewes conceived to the first service was not affected, and the total number of services recorded per group was greatest for the last treatment. The prolongation and irregularity of the oestrus cycle, the decrease of the ovaries in size, the ova and their function, and the mechanism of implantation were found to be affected by the deficiency of vitamin A in rats (Combescot et al, 1967 ; Truscott, 1947; Mason and Ellison, 1935).

Extra vitamin A supplies, improved the behaviour of Swedish cows in comming into heat (Valjuskin, 1970). The author noticed that, out of 50 injected cows with vitamin A, 43 came into heat as against 21 only out of 28 cows which were not given vitamin A supplement. Vitamin A supplementation was accompanied by vitamins E and C in the same injacom. Tagwerker (1968) and Meacham et al (1970) reported that vitamin A supplementation for cows during pregnancy and early lactation significantly improved conception rate and decreased the number of cows culled for infertility. On the other hand, complete infertility has been observed in very acutely vitamin A-deficient rats (Parkes and Drummond, 1926).

Though, vitamin A-deficient animals conceived when they were mated, but usually this was accompanied by fetal resorption back into the blood stream. Vaginal bleeding was observed and the histological lesions of genitalia represent a necrosis of cells in the placenta, associated with an