Effect of Supplementing the Diet of Lactating Ossimi Ewes with Organic Selenium on their Wool Characteristics

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ABSTRACT

A trial was carried out on thirty Ossimi ewes aged 3-4 years, belonging to the Animal Production Research Station at Sids, with live weight ranging between 45 to 50 kg. The animals were randomly divided into 3 groups, each of 10 ewes with almost equal mean live body weight. Animals were given maintenance and productive diets according to their average body weight (NRC 1988). Concentrate feed mixture composed of 22% cotton seeds, 20% molasses, 44% wheat bran, 10% yellow maize, 2.5% ground limestone and 1.5% common salt. Water was provided ad-libitum during the whole experimental period with clover hay and rice straw. The trial started 1st June and ended 1st August 2018 (2 mo. /wool growth) and included 3 groups; Control group; received the basal diet only without any supplements, the first group; was given the basal diet plus 0.23 gm selenoprotein / kg dry matter/ head/day (0.5mg available selenium), the second group; was given the basal diet plus 0.33 gm selenoprotein / kg DM /head /day (0.7mg available selenium). The trial included suckling period. The aim of this research was to study the effect of adding selenium to the diet of Ossimi ewes during suckling period on wool growth. Physical and mechanical wool properties were measured in addition to the estimation of Glutathione peroxidase (GPX) enzyme activity. Results showed that there was significant difference (P≤0.05) among groups in CWW, STL, FD, SST, ELO % and GPX enzyme activity, so, adding selenium was of a great importance at this period of lactating ewes on their wool production.

Keywords: selenium, lactation, wool production, Ossimi ewes.

INTRODUCTION

Lactation affects various wool characteristics such as the lack of fibre diameter, staple strength, staple length and clean wool weight (Masters *et al.,* 1993). The reduction greatly happens in the lactation period and causes variations which affect wool staple and strength and the processing quality of the raw wool, and this affects the wool price. Lactation is the most nutritionally demanding metabolic physiological state (Horton *et al.,* 1992).

Selenium (Se) has many biological functions for better health of living organisms, especially during pregnancy and lactation. Maternal selenium affects performance of the progeny as all nutrients required by the developing fetus are transferred from the dam through the placenta, the colostrum and the milk. Selenium acts as the catalytic center in the active sites of several antioxidant enzymes and proteins. GSH-PX is an antioxidant during embryonic development. The antioxidant enzymes respond to oxidative stress by neutralizing and eliminating reactive oxygen species (ROS) (Pappas et al., 2008).

In addition, it has been published by many authors that reductions greatly happen in wool growth rate during lactation. Overall, reproduction usually reduces annual wool growth of ewes by 10 to 14% and the greatest reduction is for ewes rearing twins (Corbett, 2000) .

So, the aim of this paper was to determine wool production and characteristics of Ossimi ewes during suckling period and the effect of adding organic selenium to their diet on wool growth.

MATERIALS AND METHODS

Study Location:

The present study was carried out at Sids Station which belongs to *Animal Production Research Institute, Agriculture. Research Center, Ministry of Agriculture, Dokki, Giza, Egypt*

Experimental groups*:*

Thirty Ossimi ewes, 3-4 years old, weighing 45 to 50 kg, were randomly divided into 3 equal groups of 10 ewes each, of almost equal mean live body weight. Animals were given maintenance and productive diet according to their average body weight, (NRC 1988).

Concentrate feed mixture composed of 22% undecorated cotton seed cake, 20% molasses, 44% wheat bran, 10% yellow corn, 2.5% ground limestone and 1.5% common salt. Water was provided ad-libitum during the whole experimental period with clover hay and rice straw. The trial started on the 1st of June and ended on 1st August 2018 and included 3 groups of ewes; Control group; received the basal diet only with no supplements, the first group; was given the basal diet supplemented with 0.23 gm selenoprotein / kg dry matter/ head/day (0.5mg available selenium), the second group; was given the basal diet supplemented with 0.33 gm selenoprotein / kg DM/ h/d (0.7mg available selenium).

Wool samples:

Wool samples were shorn at the end of the experimental period; shearing was done on August 1st 2018 and tattooed on the right mid side position 10×10cm (100cm^2). The tattooed areas were shorn to the skin at the beginning of each period.

Blood Sampling:

Blood samples were collected at the end of the experimental period; at the same timing as the shorn wool. Ten ml blood samples were collected from ten ewes of each group to assess Glutathione peroxidase activity (GPX) in their blood plasma. Samples were taken via jugular venipuncture using 18 gauge needles and 10mL heparin vacutainers. Samples were centrifuged at 3500 rpm for 15 minutes, the blood samples frozen and kept for analysis.

Physical Measurements:

The physical measurements included weight of grease and clean wool samples, staple length and fibre diameter. The grease wool weight shorn of 100 cm^2 of skin was weighed using a digital read –out balance to the nearest 0.01 gm. Clean wool weight of 100 cm^2 of shorn wool was found after extraction of residual grease by Soxhlet apparatus from scoured samples using ethyl ether b.p: 64 as a solvent. The clean wool percentage was then calculated from the yield of 100 cm^2 samples as follows: Clean scoured yield % = Weight of scoured and dried sample / Weight of greasy sample × 100. The contaminants percentage was calculated from the following equation: The grease sample weight - the clean sample weight / Grease sample weight ×100. The yield was then calculated from the yield of 100 cm^2 of shaved skin samples. Staple length was measured on 20 random staples from each sample, using a centigrade ruler to the nearest 0.25 cm. The mean staple length was then calculated with the standard error for each treatment. Fibre diameter was measured in microns using Image analyzer software (Zen, 2012, Blue edition) and (device carl-Zeiss micro-imaging G and bh) with lenses10/0.847.

Mechanical Properties:

Staple strength and elongation were measured on Staple strength that was measured by the force required to break the staple in Newton and dividing this value by the thickness of the staple (mm) (Newton per kilotex, N/Ktex). Ten staples were chosen at random from each sample and prepared for measuring their strength using the Artiest Staple Breaker (Caffin, 1980). The length of the top and the base of each broken staple in the strength tester were measured and then calculated.

calculate the elongation percentage. Thus the length of the top as a percentage from the length of both top and base was found as follows:

Thickness of the staple (kilotex) = (weight of clean dry staple / length of staple) × 100

Staple Strength (N/Kilotex) = strength (N) / thickness of staple (mm) (kilotex)

The Elongation percent = (length of top +length of base) - staple length)/ staple length) × 100.

Statistical Analysis:

Data were analyzed using general linear model (GLM) of SPSS program, (1999) (statistical product and service solutions). One -way analysis of variance (ANOVA) was adopted to study the effect of supplementing the diet of the experimental ewes with different levels of organic selenium (selenoprotein) at suckling period on wool production and growth. The following equation was used:

$x_{ij} = \mu + \alpha_i + e_{ij}$

Where x_{ij} is the observed value of the trait.

μ is the grand mean of the trait.

α_i is the effect of selenoprotein level (i=1, 2, 3)

eij is the experimental error assumed to be normally distributed with mean zero and variance of V^2.

Comparison among means was followed using Duncan's new multiple range test Duncan (1955).

RESULTS AND DISCUSSION:

Results in table (1) showed differences among groups in clean wool weights. The means of CWS were 20.25, 26.65 and 29.30 gm for the control group, 0.5 and 0.7 mg Se-supplemented groups, respectively. It was clear from this result that Se-supplementation to the diet caused a significant increase in clean fleece weight being greater in the treated groups than control group, after two months of suckling period. Lactation is a stressful period in the life of a sheep with wool growth rates negatively affected as a result (Masters *et al.,* 1993). The largest reduction in growth occurs during the first several weeks of lactation (Oddy and Annison, 1979).

During lactation period, wool growth reduced by 20-60% (Corbett, 1979). Correlations of clean fleece percentage with the other traits of Norduz fleece were not significant. Although, the correlations of staple length, single fiber actual length single fiber natural length with clean fleece percentage were significant in Karakas fleece (Snyman et al., 1998 and Wuliji et al., 1999). These results were in harmony to the previous findings of (Wilkins and Kilgour, 1982); Langlands *et al.,* (1991a and 1991b), who reported that wool is very sensitive to the lack of selenium so that, Se supplementation significantly increased wool production significantly.

The percentage of contaminants, recorded 35.38, 32.87 and 20. 27% for the control group, 0.5 mg Se-supplemented group and 0.7 mg Se-supplemented group respectively, differences were significant (P≤0.05). This result indicates that adding selenium to the diet of sheep (0.5 and 0.7 mg Se-supplemented) might have reduced the percentage of contaminants El-Sherbiny *et al.,* (2014).

Results in table (2) showed that, addition of selenium in the form of selenoprotein to the diet of Ossimi suckling ewes caused an increase in staple length (STL) being greater in the group which received 0.7 mg Se (5.25±0.25) cm. As shown in table (2) the means of staple length were 3.95±0.20, 4.75±0.35 and 5.25±0.25 cm for the control group, the 0.5 and the 0.7 mg Se-supplemented groups, respectively. The decreased wool growth in lactating ewes was a result of competition for nutrients among metabolic processes (Oddy and Annison, 1979). Nutrients should be shared between wool and milk production, wool receiving very low percentages than milk production (McNeil *et al.,* 1997).

Staple length increased significantly by increasing the level of selenoprotein in the diet of lactating ewes, the reason for such increase in staple length can be explained on the light of the results of Morel and Barouki (1999) who noticed that, selenoproteins have great metabolic roles as antioxidants and affect the redox status of the cells.

Results in table (2) showed that, fibre diameter (FD) increased significantly in suckling Ossimi ewes (P≤0.05) with the addition of 0.5 mg Se to the diet (35.10 ±0.80 μm) and also with the addition of 0.5 mg Se to the diet (36.30 ±0.65 μm) compared to the control group (32.55 ±0.75 μm). This result was in contrast with Doney (1964) who found a reduction of about 12% in wool growth rate due to suckling in Scottish Blackface sheep. A reduction of 9-15 % (P≤0.001) over the whole period of suckling in the pursuit experiment occurred despite the large increase in feed intake that was indicated by faecal outputs. This reduction may result from competition for nutrients between milk and wool production, although it is possible that some other aspects of the physiological state of lactation are involved. The similarity of the average daily wool growth rates during the final period when no ewes were lactating indicates that wool production rises rapidly when lactation ceases.

Results in table (3) showed that, there were significant differences (P≤0.05) among groups in staple strength (SST). The means of SST were 25.35, 33.10 and 36.40 N/Ktex for the control group, 0.5 and 0.7 mg Se-supplemented groups, respectively. In this experiment Se-supplementation to the diet caused an increase in staple strength being greater in the third group 0.7 mg Se-supplemented. Other factors may also influence the effects of reproduction on staple strength.

The strength of wool fibers is influenced markedly by the nutrient supply via effects on fiber diameter and changes in intrinsic strength (Reis *et al.*, 1992). The characteristics of this FDP have been shown to influence staple strength (Hansford and Kennedy, 1988; Denney, 1990 and Peterson, 1997). The trend of staple elongation was similar to that of staple strength. Organic Se sources supply the element to molecules containing **Se**, but selenomethionine is also deposited in body protein by substituting methionine in protein molecules. Consequently, the **Se** concentration in tissues and body fluids was higher when **Se** was fed in the organic form compared to the

inorganic form (Beilstein and Whanger, 1986 and Van Ryssen *et al.,* 1989).

Results in table (4) showed that there were significant differences among treatments in the level of glutathione peroxidase enzyme activity (GPX) in the blood plasma of suckling ewes (P≤0.05).It was higher in the treated groups compared to the control group. GPX level in the control group was 4.30 ± 0.60 (μU/ml), while in the 0.5 Se-supplemented ewes was 7.95 ± 0.55 (μU/ml) and the level of GPX in the 0.7 Se-supplemented ewes was 12.25 ± 1.40 (μU/ml) after two months suckling period. In selenium deficiency situation, hepatic glutathione (GSH) synthesis is increased and this depletes cellular cysteine (Burk, 1983), so it may impair physiological processes like growth and wool production where cysteine is required for protein synthesis. Indeed, GSH synthesis seems to compete with wool growth for cysteine (Liu and Eady, 2005). Low concentrations of GSH can be associated with impaired animal health as cysteine and GSH play a key role in the regulation of the immune response (Dröge *et al.,* 1994). Therefore, considering that GSH is a reservoir of cysteine, selecting for both GSH concentrations and wool growth rate might result in improvements in both wool production and health status (Liu and Eady, 2005). In the meantime, when selenium deficiency is diagnosed, its supplementation is recommended to improve the development of resistance and resilience of sheep to gastro intestinal parasites (Celi, *et al.,* 2010).

CONCLUSION

Addition of selenoproteins to the diet of suckling ewes is a practical method to reduce the effect of suckling stress on wool produced from ewes, through the production of GPX which directly protects the follicle cells from damage and increases the cell mitotic division. Further research is required to compare the effect of selenium supplementation in dry and suckling ewes on wool growth.

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Table 1: Means ± standard errors of clean weights of wool samples (C.W.S) and percentage of contaminants (C%) after two months suckling period:

Variables Experimental groups	C.W.S (gm)	C%
Control group	20.25 ± 1.65^{b}	35.38
0.5 mg Se supplemented	26.65 ± 1.61^{a}	32.87
0.7 mg Se supplemented	29.30 ± 1.67^{a}	20.27

Means within columns with different superscripts are significantly different (P≤0.05).

Table 2: Means ± standard errors of staple length (STL) and fibre diameter (FD) after two months suckling period:

Variables Experimental groups	STL (cm)	FD (μm)
Control group	3.95 ± 0.20^{b}	32.55 ± 0.75^{b}
0.5 mg Se supplemented	4.75 ± 0.35^{ab}	35.10 ± 0.80^{a}
0.7 mg Se supplemented	5.25 ± 0.25^{a}	36.30 ± 0.65^{a}

Means within columns with different superscripts are significantly different (P≤0.05).

Table 3: Means ± standard errors of staple strength (SST) and elongation percentage (ELO %) after two months suckling period**:**

Variables Experimental groups	SST (N/Ktex)	ELO %
Control group	25.35 ± 1.25^{c}	20.10 ± 1.10^{b}
0.5 mg Se supplemented	33.10 ± 0.80 ^{b}	33.70 ± 10.00^{a}
0.7 mg Se supplemented	36.40 ± 0.75^{a}	35.30 ± 1.05^{a}

Means within columns with different superscripts are significantly different (P≤0.05).

Table 4: Means ± standard errors of glutathione peroxidase (GPX) enzyme level of activity after two months suckling period:

Variables Experimental groups	GPx (μU/ml)
Control group	4.30 ± 0.60^{c}
0.5 mg Se supplemented	7.95 ± 0.55^{b}
0.7 mg Se supplemented	12.25 ± 1.40^{a}

Means within columns with different superscripts are significantly different (P≤0.05).

تأثير إمداد عليقة النعاج الأوسيمي الحلابة بالسيلينيوم العضوي علي خصائص الصوف المنتج منها

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الملخص العربي

أجريت التجربة على عدد ثلاثين نعجة أوسيمى خلال فترة الرضاعة بمحطة بحوث سدس التابعة لمعهد بحوث الإنتاج الحيوانى – مركز البحوث الزراعية – وزارة الزراعة - الدقى. تتراوح أعمارهم من 3-4 سنوات ومتوسط أوزانهم يتراوح بين 45 إلى 50 كجم. تم تقسيم الحيوانات بشكل عشوائي إلى 3 مجموعات بكل منها عشرة نعاج متساوية تقريبا فى متوسط وزن الجسم الحي. أعطيت الحيوانات علائق حافظة وإنتاجية وفقًا لمتوسط وزن الجسم الحى مكونة طبقاً لمقررات المجلس القومى الأمريكى (عام 1988 م). وبدأت التجربة في 1 يونيو واستمرت حتى 1 أغسطس 2018م (فترة نمو الصوف شهرين) حيث قسمت الحيوانات إلى 3 مجموعات. المجموعة الأولى المجموعة المقارنة حيث غذيت على العليقة الأساسية فقط دون أي إضافات، المجموعة الثانية غذيت على العليقة الأساسية بالإضافة إلى 0.23 جم من السلينيوبروتين / كجم مادة جافة / للرأس / اليوم (0.5 ملجم من السلينيوم المتاح)، المجموعة الثالثة غذيت على العليقة الأساسية بالإضافة إلى 0.33 جم من السلينيوبروتين / كجم مادة جافة / للرأس / اليوم (0.7 ملجم من السلينيوم المتاح) وكان الهدف من هذه الدراسة هو دراسة تأثير إضافة السلينيوم إلى غذاء النعاج الأوسيمي خلال فترة الرضاعة على نمو الصوف. تم تقييم خصائص الصوف الفيزيائية والميكانيكية بالإضافة إلى تقدير نشاط إنزيم الجلوتاثيون بيرأوكسيديز. كانت هناك اختلافات معنوية بين المجموعات فى وزن الصوف النظيف وطول الخصلات وقطر الألياف ومتانة واستطالة الخصلات ونشاط إنزيم الجلوتاثيون بيرأوكسيديز. الخلاصة: تعد إضافة السلينوبروتين إلى غذاء النعاج خلال فترة الرضاعة طريقة عملية لتقليل تأثير فترة الرضاعة على الصوف الناتج من النعاج من خلال إنتاج إنزيم الجلوتاثيون بيرأوكسيديز الذي يحمي مباشرة خلايا الحويصلات من التلف ويزيد من انقسام الخلية. وهناك حاجة إلى مزيد من البحث لمقارنة تأثير مكملات السلينيوم في النعاج الجافة والمرضعة على نمو الصوف.

الكلمات الاسترشادية: سيلينيوم، الحلابة، إنتاج الصوف، النعاج الأوسيمى.