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# SOME CHARACTERISTICS OF WOOL FOLLICLES AND FIBRES IN YEARLING BARKI EWES AS AFFECTED BY ADDITION OF GROWTH PROMOTERS TO THE DIET

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## ABSTRACT

The present study aimed at investigating the effect of high level of feeding and antibiotic growth promoters (flavomycin and monensin) on the wool follicle activities and fibre growth in sheep. Sixty Barki ewe lambs at 4.5 months of age and 20.6 kg body weight were randomly taken from the main flock of Mariout Experimental Station of the Desert Research Center and divided into six equal groups. Five groups were offered a basal diet covering the requirements for growth rate of 100 gm/day. Of these five groups the 1st was the control, the 2nd and the 3rd were supplemented with flavomycin at the rate of 20 and 40 mg/head/day, respectively. The 4th and the 5th groups were offered monensin at the rate of 10 and 20 mg/head/day, respectively. The sixth one was given a high level of feeding to cover a growth rate of 150 gm/day. Treatments continued for eight months. Wool follicle activity and fibre growth were measured using histological and histochemical sections from the skin of the yearling ewes sampled at 12.5 month of age.

The treated animals did not show any difference in their first fleece weight. High level of nutrition significantly ($p<0.05$) increased the dimensions of both primary and secondary wool follicles. The histochemical analysis showed that the high level of feeding increased carbohydrate concentration, protein content and activity of the alkaline phosphatase enzyme indicating high activity of follicles. In addition, the same treatment led to an increase ($p<0.05$) in the diameter of both primary and secondary fibres.

Neither wool follicles nor fibres were affected by the administration of both flavomycin 40 mg/head/day and monensin 10 mg/head/day. However, the level of 20 mg/head/day of both two types of growth promoters showed a considrable improvement in the traits under study towards more follicles activity and wool growth**.** It was concluded that using high level of nutrition or administrating flavomycin or monensin at the rate of 20 mg/head/day would improve wool follicle characteristics in yearling Barki ewes towards increasing their activities.

**Keywords**: sheep, nutritional level, growth promoters, wool and skin characteristics

## INTRODUCTION

Wool of the Barki sheep, prevailing in the northwestern coastal desert of Egypt, is considered the second product that contributes to the economic value of that breed of sheep. Wool is an important natural coat for sheep especially under semi-arid conditions. Not only it protects the animals from

extremes of climatic and environmental conditions but it is also utilized as a textile fibre. Recently, a number of antibiotic feed additives were fed to ruminants to increase the availability of protein to the animals. The ionophore compounds tend to decrease the degradation of dietary protein within the rumen (Chalupa, 1984). In addition, they change the pattern of volatile fatty acids production in favor of propionate, which is energetically more efficient to the animal and reduce the requirements for amino acids in gluconeogenesis (Casson *et al*., 1986). Moreover, monensin was found to significantly decrease rumen ammonia (Chen and Russel, 1991 and Abdel-Rahman, 1998), which led to increase ruminal escape of dietary protein and peptides flow from the rumen (Flanlkner *et al*., 1985 and Chen and Russel, 1991).

MacGregor and Armstrong (1984) found that the glycopeptide antibiotic avoparcin increased the absorption of amino acids from the small intestine. They added that avoparcin and other antibiotics used in monogastric feeding might reduce the bacterial challenge to the intestinal mucosa and thereby increase the biological value of diet protein and decrease the animals requirements for amino acids for protein synthesis within their bodies. Since wool is chemically a protein then the effect of antibiotic growth promoters is very important for wool production. Rowe *et al*. (1982) suggested that the action of flavomycin on wool production was mainly post ruminal.

The aim of the present study was to determine the response of wool growth in terms of fleece weight, fibre diameters and skin histology and histochemistry in Barki ewes to high level of nutrition as growth promotion method and the inclusion of antibiotic growth promoters, flavomycin and monensin, in their diet.

## MATERIALS AND METHODS

Sixty Barki ewe lambs (140.3 $\pm$ 1.12 days old and 20.6 $\pm$ 0.37 kg live body weight) were chosen at random from the main flock at Mariout Experimental Station of the Desert Research Center, which is located 35 km south west of Alexandria. These experimental animals were divided randomly into six groups, ten ewe lambs per each. The control group (C) was fed on a basal level that provided maintenance requirements and daily gain of 100 gm/day according to Kearl (1982). The second to fifth groups (F20, F40, M10, and M20) were fed the basic level in addition to growth promoters 20, 40 mg flavomycin/head/day and 10, 20 mg monensin/head/day, respectively. Hoechst (Western Germany) provided flavomycin, while Ilanco Company (Egypt) provided monensin. The last group (HL) was fed on a high nutritional level that covered maintenance requirements and growth of 150 gm/day without any additives. The ration consisted of a concentrate mixture (cotton seed cake 50%, wheat bran 18%, yellow maize 15%, rice polish 11%, molasses 3%, limestone 2% and common salt 1%) plus Berseem (*Trifolium alexandrinum*) hay. The diet was given at 50% concentrate mixture and 50% hay. The amounts of nutrients were continuously adjusted according to the increase in live body weight. These treatments lasted 8 months until the animals became 12.5 months of age. At that age, the animals were weighed then the fleece was shorn and weighed. Skin samples were collected from

the mid side region of randomly chosen five experimental animals from each group, and fixed in 10% formalin, then embedded in paraffin-wax, sectioned at 6-8 µm thickness and stained with Haematoxylin and Eosin (Drury and Wallington, 1980). The histological measurements included the external and internal diameters of both primary and secondary wool follicles and wool fibre diameters. These parameters were measured using an image analyzer (LEIAQ 500 MC) with lens 40/0.65. The follicle wall thickness was calculated.

To conduct histochemical analysis of the wool follicles, the sections were stained according to Pearse (1968) for PAS-positive substances (Periodic acid Shiff), proteins (Bromphenol blue) and alkaline phosphatase (Gomori's calcium cobalt).

Data of fleece weight, body weight and all histological measurements were statistically analyzed by SAS software (SAS, 1998) using one way analysis of variance, followed by Duncan's multiple range test. The results of the histochemical analyses were demonstrated as grades, + few, ++ moderate, +++ intense concentration.

## RESULTS AND DISCUSSION

### 1. Histology of wool follicles:

The use of feed additives (flavomycin and monensin) and high level of nutrition showed a significant effect on the size of wool follicles which might mean affecting its activity. The changes in the external and internal diameters (ED and ID) and wall thickness (WT) of both primary (PF) and secondary (SF) wool follicles were demonstrated in Table 1 and Figures 1 and 2.

**Table (1): Average values (Means ± SE) of external and internal diameters (ED and ID) and wall thickness (WT) in µm of the primary and secondary follicles of different groups .**

| Group | Primary follicles | | | Secondary follicles | | |
|---|---|---|---|---|---|---|
| | ED | ID | WT | ED | ID | WT |
| C | 113.2 ±4.09b | 51.11 ±1.28b | 62.13 ±4.30a | 74.98 ±1.13a | 21.08 ±0.40c | 53.89 ± 0.95 a |
| F20 | 111.0 ±4.87b | 42.14 ± 0.94c | 68.87 ±4.85a | 62.67 ±1.46c | 22.35 ±0.46b | 40.32 ± 1.20 b |
| F40 | 86.4 ± 3.55c | 42.92 ±2.14c | 43.47 ±2.82b | 52.79 ±1.36d | 18.08 ±0.62d | 34.71 ± 1.12 c |
| M10 | 64.5 ±2.89d | 32.02 ±1.87d | 32.50 ±2.26b | 45.68 ±1.10e | 13.34 ±0.34e | 32.34 ± 1.02 c |
| M20 | 110.9±5.90b | 52.29 ±4.30b | 58.64 ±5.89a | 66.28 ±1.13bc | 22.75 ±0.45bc | 43.53 ± 0.83 b |
| HL | 131.2 ±3.76a | 67.55 ±3.70a | 63.64 ±3.75a | 69.19 ±1.70b | 27.79 ±0.54a | 41.40 ± 1.44 b |

**C = control, HL = high nutritional level, M20 = monensin 20 mg, M10 = monensin 10 mg, F20 = flavomycin 20 mg, F40 = flavomycin 40 mg. Number of animals in each group = 5, number of examined primary follicles in each animal = 150, number of examined secondary follicles in each animal = 350. Means in the same column with the same letter are not significantly different (p<0.05).**

fig1,2

Group differences ($p<0.05$) occurred, where the HL group showed the highest ($p<0.05$) dimensions of PF (131.2 µm ED and 67.55 µm ID) as shown in Fig. 1. Following this group was the C, F20 and M20 groups (113.2, 111.0 and 110.9 µm ED and 51.11, 42.14 and 52.29 µm ID, respectively). Concerning WT, significant ($p<0.05$) higher values were shown by the animals of groups F20, HL, C and M20 (58.64 to 68.87 µm), while groups F40 and M10 had the lowest values (43.47 and 32.50 µm, respectively).

These results of PF dimensions demonstrated that the high level of feeding and administration of flavomycin and monensin in the rate of 20 mg/h/d increased the size and activity of the PF, which would be reflected on wool production. Adding 40 mg/h/d flavomycin and 10 mg/h/d monensin to the diet was of no benefit (Fig. 2). The results of secondary follicle dimensions confirmed this concept. The animals of F40 and M10 groups showed lower ($p<0.05$) values of ED, ID and WT of secondary follicles (Figs. 1 and 2). Abdelaziz *et al*. (2000) stated that wool growth fluctuated with varying levels of nutrition and this was seen in variations in length and diameter of the wool fibres. Thus, the intake of energy and protein above that required for the maintenance led to the formation of body protein and enhancement of wool production. Wool growth can only take place if the necessary precursor materials are supplied to the follicles and both nutrition and metabolic rate may limit this. In the present study, the high level of nutrition affected ($p<0.05$) the PF dimensions through increasing the ED, ID by 15.9% and 32.2%, respectively. High level of nutrition led to an increase, but not significantly, in WT by 2.4%. In PF also an insignificant increase was observed in WT (10.8%) by flavomycin 20 mg/h/d, and in ID (2.3%) by monensin 20 mg/h/d. In SF, only ID was significantly ($p<0.05$) increased either by high level of nutrition (31.8%), flavomycin 20 mg/h/d (6%) or monensin 20 mg/h/d (7.9%), while ED and WT were not affected by treatments. These dimension increments might be attributed to the increase in feed utilization efficiency. In agreement, El-Sherif *et al*. (2001) found better utilization of feed by growing lambs when adding flavomycin and monensin at the rate of 20 mg/h/d. Lee *et al*. (1990) found better utilization of feed by adding 22 than 33 mg monensin/kg diet. El-Basiony (1994) found that using flavomycin at the level of 16 – 32 mg/kg diet improved feed conversion efficiency during growth in Ossimi sheep. Murray *et al*. (1989) explained that inclusion of growth promoters in the diet increased the molar proportion of propionate in rumen fluids, which might support the follicle growth rate and activities. In addition, the increase in follicle dimensions in the groups HL, F20 and M20 could be histologically attributed to the morphological changes in the connective tissue sheath which accompanied that of the follicles during the activity periods (Montagna and Ellis, 1958). They added that during activity, the outer root sheath showed an increase in its thickness due to large number of cell layers leading to relatively large fibres. Mahgoub *et al*. (1974) stated that the relation between both size and activity of the follicles was mostly quantitative. They demonstrated that in case of inner root sheath the only difference between small and large follicles seemed to be in the size of the cells of Henle's and Huxley's layers and the inner root sheath cuticle.

**2. Histochemistry of wool follicles:**

In the connective tissue sheath, some carbohydrate substances were found inside the cytoplasm of fibroblasts and also extracellulary along the fibres. The outer root sheath of active hair follicles was also laden with carbohydrates (Fig. 3). Active wool follicles were stated to be always rich in carbohydrates (Montagna, 1956 and Matter *et al*., 1998). The carbohydrates are considered the sign of follicle activity according to the assumption of Montagna (1956) that the carbohydrates in the outer root sheath is the source of energy for protein synthesis during fibre growth. In this study, the presence of carbohydrates in both PF and SF showed an increased follicle activity in the HL group (Fig. 3) followed by the F20 group in the PF and by the M20 group in the SF (Table 2), whereas the lowest concentration of carbohydrates (Fig. 4) were found in the groups of M10 and F40. Haimoud *et al*. (1996) stated that monensin increased ruminal propionate concentration (about 50%), and significantly decreased acetate:propionate ratio, in addition to a decrease in butyrate level. Flachowsky and Richter (1991) demonstrated that increasing propionate is energetically more efficient to animals in performance and high productivity.

Light can also be thrown on glycogen metabolism through studying the phosphatase enzymes responsible for its build-up and breakdown. The improvement in growth rate and activity of both wool follicle types in Barki ewes that occurred in some treatment groups (as shown in Table 2) could be achieved by the effect on the site activity of the alkaline phosphatase enzyme. It is clear from Table (2) that the highest activity of the PF as represented by the activity of the alkaline phosphatase enzyme were found in the HL, F20 and M20 groups, while the control group showed the highest follicle activity in the case of SF. Ryder and Stephenson (1968) explained that phosphatase enzymes function in the last stage of glycogen breakdown, which is the release of glucose from glucose-6-phosphate or glucose-1-phosphate. Thus the presence of a phosphatase in the papilla (or papilla vessels) suggested that at least some of the glucose reach the papilla as glucose-6-phosphate. Support for this suggestion has been obtained from the positive reaction found in the papilla of the wool follicle when glucose-6-phosphate was used as substrate. They added that the formation of a glucose phosphate is the first stage in its breakdown to produce energy.

**Table (2): Histochemical reactions in primary and secondary wool follicles of different groups.**

| Group | Primary follicles | | | Secondary follicles | | |
|---|---|---|---|---|---|---|
| | Carbohydrates | Proteins | Alk. Ph. | Carbohydrates | Proteins | Alk. Ph. |
| C | ++ | ++ | ++ | ++ | +++ | +++ |
| F20 | +++ | +++ | +++ | ++ | ++ | ++ |
| F40 | + | ++ | + | + | + | + |
| M10 | + | ++ | + | + | + | + |
| M20 | ++ | +++ | +++ | +++ | ++ | ++ |
| HL | +++ | +++ | +++ | ++ | ++ | ++ |

**Alk. Ph. = alkaline phosphatase, C = control, HL = high nutritional level, M20 = monensin 20 mg, M10 = monensin 10 mg, F20 = flavomycin 20 mg, F40 = flavomycin 40 mg. Number of animals in each group = 5, + = few, ++ = moderate, +++ = intense.**

fig3,4

The distribution of the general proteins as demonstrated by the bromphenol blue stain in wool follicles of the different groups of Barki ewes showed that both outer and inner root sheaths of the wool follicles possessed high amounts of proteins (Fig. 5). In comparison between the experimental groups (Table 2), the HL group showed the highest protein contents in the PF (Fig. 5) followed by the F20, M20 and C groups. In case of SF, the C group recorded the highest amount of protein, while the groups HL, F20 and M20 showed moderate amounts. The groups F40 and M10 had the lowest protein contents (Fig. 6). Parmar *et al*. (1988) stated that the protein content was larger in the active follicle sheaths probably due to the increased protein synthesis in the cellular proliferation. Additionally, increased propionate by antibiotic feed additives was suggested to spare amino acids normally used for gluconeogenesis (Leng *et al*., 1967) and stimulate body protein synthesis (Potter *et al*., 1968).

**3. Wool fibre diameter:**

Table (3) shows the mean diameter of fibres produced from both PF and SF of different experimental groups. The diameters increased ($p<0.05$) in the HL group than in the C group, 64.74 vs. 49.42 µm in primary fibres and 27.36 vs. 20.69 µm in secondary fibres, respectively. In agreement, Doyle *et al*. (1995) found that high supplementary feeding significantly affected fibre diameter. Confirming this result, Scobie *et al*. (1998) found that the fibre diameter was greater in sheep given high than low protein diet. An insignificant increase in diameter in both types of fibres was found using monensin at 20 mg/h/d (51.32 µm for primary fibres and 22.42 µm for secondary fibres). The smallest diameters in both fibre types were recorded in the M10 group, which indicated the importance of growth promoter level. Using feed additives was proved to stimulate protein anabolism, provide amino acids and increase retention of nitrogen, potassium, phosphorus and calcium that were needed for building protein and bony tissues (Glick *et al*., 1965; Leng *et al*., 1967; Potter *et al*., 1968 and Mosely *et al*., 1977).

**Table (3): Averages (Means ± SE) of fibre diameter (µm) produced by primary and secondary follicles in different groups**

| Group | Primary fibres | Secondary fibres |
|---|---|---|
| C | 49.42 ± 1.247 b | 20.69 ± 0.374 c |
| F20 | 41.61 ± 0.893 c | 21.89 ± 0.477 bc |
| F40 | 42.08 ± 2.093 c | 17.42 ± 0.650 d |
| M10 | 31.49 ± 1.825 d | 12.74 ± 0.340 e |
| M20 | 51.32 ± 4.233 b | 22.42 ± 0.489 b |
| HL | 64.74 ± 3.177 a | 27.36 ± 0.513 a |

**C = control, HL = high nutritional level, M20 = monensin 20 mg, M10 = monensin 10 mg, F20 = flavomycin 20 mg, F40 = flavomycin 40 mg. Number of animals in each group = 5, number of examined primary follicles in each animal = 150, number of examined secondary follicles in each animal = 350., Means in the same column with the same letter are not significantly different ($p<0.05$).**

fig5,6

Roborzynski (1992) showed that using antibiotic growth promoter lasalocid improved performance traits in sheep and the best response was in the yield and quality of wool. However, using flavomycin in this study had no effect on fibre diameter. Murray *et al*. (1992) showed that there was no effect of flavomycin on fibre diameter although the wool growth increased significantly ($p<0.05$) by 14.5%, but in adult sheep only.

**4. Fleece weight:**

Table (4) demonstrates that at 12.5 months of age neither live body weight nor fleece weight differed significantly among the experimental groups. The rate of wool growth in sheep is measured as the weight of fleece wool production. It was proved to be very sensitive to changes in energy intake and associated with the efficiency of conversion of feed to wool (Ryder and Stephenson, 1968). Dittrich *et al*. (1991) showed that both nicotinic acid and avoparcin caused an increase in staple length and wool yield by 7 and 2%, respectively. In the present study, high feeding level showed insignificant increase in the fleece weight than in the control group (3.519 vs 3.316 kg). In the present study antibiotic growth promoters had no effect on the weight of the first fleece. Murray *et al*. (1992) found an increase in wool growth that equaled 14.5% using flavomycin, but only in adult Collinsville Merino sheep. It seemed that antibiotic growth promoters need prolonged administration to exert an effect on fleece weight. Murray *et al*. (1990) added that flavomycin would only increase wool growth when the additional amino acids absorbed from the intestine were those limiting wool formation. Accordingly, the response could only be expected when the basal diet provides high levels of sulfur-containing amino acids protected from the rumen degradation by flavomycin.

**Table (4): Average values (Means ± SE) of live body and fleece weight (kg) in different groups**

| Group | Live body weight | Fleece weight |
|---|---|---|
| C | 32.15 ± 1.915 a | 3.316 ± 0.221 a |
| F20 | 33.22 ± 1.656 a | 3.162 ± 0.252 a |
| F40 | 31.40 ± 2.212 a | 3.048 ± 0.399 a |
| M10 | 33.20 ± 1.564 a | 3.399 ± 0.386 a |
| M20 | 34.00 ± 1.167 a | 3.215 ± 0.215 a |
| HL | 32.80 ± 1.525 a | 3.519 ± 0.223 a |

**C = control, HL = high nutritional level, M20 = monensin 20 mg, M10 = monensin 10 mg, F20 = flavomycin 20 mg, F40 = flavomycin 40 mg. Number of animals in each group = 10, Means in the same column with the same letter are not significantly different ($p<0.05$).**

## CONCLUSION

Although there was no significant differences in fleece weight between different treatment groups, important effects were observed. In the present study, using high level of nutrition increased ($p<0.05$) the PF size by increasing the ED (15.9%), ID (32.2%) and WT (2.4%) indicating high follicles activity. In addition the ID of the SF increased ($p<0.05$) through a high level of

nutrition (31.8%). The concentration of cellular carbohydrates in both PF and SF showed an increased follicle activity in the HL group. It was confirmed by the high activity of the alkaline phosphatase enzyme in the PF in the same group. Moreover, the HL group showed the highest protein contents in the PF, while had moderate contents in the SF. The diameter of both primary and secondary fibres increased ($p<0.05$) by increasing the level of nutrition.

Concerning growth promoters, flavomycin 40 mg/h/d and monensin 10 mg/h/d had no effect on wool follicles and fibres, while both flavomycin and monensin at the level of 20 mg/h/d showed some important effects. In PF an insignificant increase was recorded in WT (10.8%) by flavomycin 20 mg/h/d, and in ID (2.3%) by monensin 20 mg/h/d. The ID of secondary follicles were increased ($p<0.05$) by flavomycin 20 mg/h/d (6%) and monensin 20 mg/h/d (7.9%). The intense cell carbohydrates showed an increased PF activity in the F20 group and SF activity in the M20 group. Also, higher activities of the PF as represented by the intense alkaline phosphatase enzyme found in the F20 and M20 groups as well as in the HL group. The protein contents in the cells of PF were high in F20 and M20 groups, but followed that of the HL group. In case of SF, both F20 and M20 groups showed moderate protein contents. An insignificant increase in diameter of both primary and secondary fibres was found using monensin at the level of 20 mg/h/d. However, using flavomycin in this study showed no effect on fibre diameter.

It can be concluded that high level of nutrition would achieve an improvement in the performance of wool follicles, hence wool production. Both flavomycin and monensin at the level of 20 mg/h/d would be expected to exert the same effect at the condition of increasing the availability of sulfur amino acids as suggested by Murray *et al*. (1990). Using a combination of high level of feed and growth promoters might double the benefits which would require more investigations. However, the economic evaluation is needed to determine the rate of return from each treatment, since the cost of increased feed stuff might obscure the increase in wool production. Moreover, these treatments must be administrated for longer periods to investigate their effect on the successive fleeces. It is expected to have more effects from growth promoters when animals become adult as shown by Murray *et al*. (1992).

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## تأثير إضافة منشطات النمو إلى العلائق على خصائص بصيلات وألياف الصوف فى حوليات الأغنام البرقى

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يهدف هذا البحث إلى دراسة تأثير مستوى التغذية المرتفع ومنشطي النمو الفلافوميسين والمونسين على نمو و نشاط بصيلات الصوف فى الحملان البرقى. استخدم فى هذه الدراسة ٦٠ حولية برقى عند عمر ٤,٥ شهر ومتوسط وزن حي ٢٠,٦ كجم. اختيرت هذه الحيوانات من قطيع محطة بحوث مريوط التابعة لمركز بحوث الصحراء. قسمت الحيوانات الى ٦ مجموعات غذيت منها ٥ مجموعات على مستوى أساسي يغطى معدل نمو ١٠٠ جم /اليوم وهى كالآتي: المجموعة الأولى (المقارنة)، المجموعة الثانية والثالثة أضيف لهما فلافوميسين بمعدل ٢٠ و ٤٠ مجم/الرأس/اليوم على التوالي، المجموعة الرابعة والخامسة أضيف لهما المونسين بمعدل ١٠ و ٢٠ مجم/الرأس/اليوم على التوالي. المجموعة السادسة لم يقدم لها أي منشط نمو ولكن غذيت على مستوى مرتفع يغطى معدل نمو يومي ١٥٠ جم/اليوم. استمرت المعاملات ٨ شهور عندما وصلت الحيوانات لعمر الجز (١٢,٥ شهر) حيث تم الجز وأخذت عينات الجلد لفحصها هستولوجيا وهستوكيميائيا لدراسة نشاط بصيلات الصوف ونمو الألياف بها.

أظهرت النتائج ما يلي:-

- لم تظهر الحيوانات فروق معنوية فى وزن الجزة ، وهى أول جزة يتحصل عليها من هذه الحيوانات.
- أدت التغذية المرتفعة إلى زيادة معنوية على مستوى ٥% فى أبعاد بصيلات الصوف الأولية والثانوية، زيادة تركيز المواد الكربوهيدراتية والبروتينية وزيادة نشاط انزيم الفوسفاتيز القاعدي فى هذه البصيلات مما دل على زيادة معدل النشاط الحيوي بها. كما أدت هذه المعاملة إلى زيادة معنوية فى قطر الألياف الأولية والثانوية.
- لم يؤدى إضافة الفلافوميسين بمستوى ٤٠ مجم/الرأس/اليوم والمونسين بمعدل ١٠ مجم/الرأس/اليوم إلى أي تغير فى ألياف وبصيلات الصوف.
- إضافة ٢٠ مجم/الرأس/اليوم من كلا منشطي النمو الفلافوميسين والمونسين أدت الى تغير فى الصفات المدروسة بما يدل على حدوث تحسن فى نمو الألياف و نشاط بصيلات الصوف.

أستنتج من الدراسة أن استخدام مستوى مرتفع من التغذية أو إضافة أي من الفلافوميسين أو المونسين بمعدل ٢٠ مجم/رأس/يوم قد أدى إلى تحسن فى صفات بصيلات الصوف بما يدل على زيادة نشاطها الحيوي.