# Hair and Follicles Characteristics during Summer and Autumn Seasons of Shami Goat Raised in North Sinai

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**Abstract:** This study aims to investigate the difference s of Shami goat fibers and follicles in summer and autumn seasons. Outer coat fibers had average fiber diameter of63.2 µm with medullated fibers represent50.2% of total fibers and medulla occupied about 42.5 % of total fiber diameter. Fibers with diameter below 50 µm represent 31% of total fibers and this percent is too high and allude to the ability Shami hair to be added with wool blend to produce yarns. Inner fibers had 18 µm of average fiber diameter with average length of 0.86 cm at the end of autumn season. Significant differences were found between all follicles measurements between summer and autumn seasons. Similar ratios found between external diameter of both primary and secondary follicles to each other in the same season and the same ratio of each follicle type from autumn to summer reflect the harmony and symmetrical relationship between the primary and secondary follicles. The differences between outer and inner root sheath during studied seasons were also discussed.
[Helal, A. and Hekal, S.A. **Hair and Follicles Characteristics during Summer and Autumn Seasons of Shami Goat Raised in North Sinai.** *J Am Sci* 2014;10(8):191-198]. (ISSN: 1545-1003). http://www.jofamericanscience.org. 26

**Key words:** Hair, Follicles Characteristics, Summer and Autumn Seasons, Shami Goat, North Sinai

## 1. Introduction

In desert, goat is one of the common animals can survive at such harsh condition, for that goat was the first domesticated animal in the hot and arid regions of the world (Alamer, 2010). Desert is not only hot stress but it's also cold stress during dawn. Hair as a materials used in making Bedouins tents, it plays an important role in Bedouins life as well as animal adaptability. Shami goats is one of these exotic breeds raised in Egyptian desert and become desirable from farmers and considered as promising breed in this areas. Hair production and characteristics changed significantly with seasons (Helal, 2012). The aim of this work is to put in focus the morphological traits of coat fibers as well as histological and histochimical characteristics of shami goats skin follicles during two consecutive seasons (summer and autumn).

## 2. Materials and methods

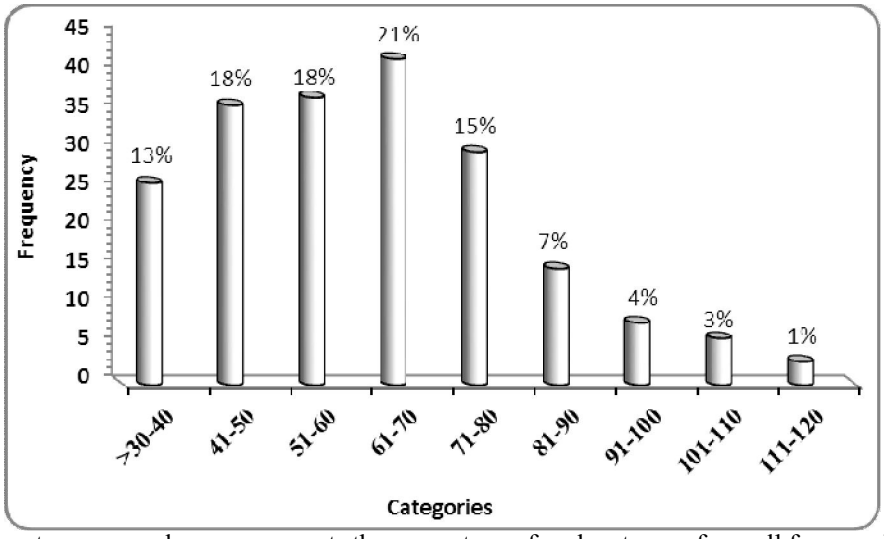
Experimental work was done at a small farm related to Desert Research Center in Abu-El-Feta Village which lies at 20 km of El-Arish City, Northern Sinai, Egypt, between latitudes 31° 7' 54.84 " N and longitudes 33° 48' 11.52" E. Four adult Bucks of Shami goats with light brown color and long hair were used in each season and they were chosen randomly from the flock related to Desert Research Center. The animals were at 18 months of age, the live weights were 49.22± 1.74 kg at the commencement of the study. The animals were feed Alflfa hay twice daily (11:00 and 18:00 h) based on LBW to meet the metabolic energy maintenance requirement according to Kearl (1982). Fresh water was given once daily *ad.lib*. Throughout the experimental periods, animals proved to be free from internal and external parasites. Skin samples were taken from the mid side position which is considered as a standard follicle population area over the whole skin surface (Schleger and Turner, 1960). The skin specimens were carefully taken from the animals by means of a curved scissors, flattened on foam and fixed in calcium formol about 24 hours according to Barker (1958). Follicle dimensions including the external, internal and fiber diameters were measured by adding the major and minor diameters of each follicle and dividing by two to avoid inaccuracies due to obliquely cut follicles. The follicle wall thickness was determined by subtraction of the average of internal diameter from the average of external diameter for each follicle. For the histochemical investigation, Mercury Bromophenol Blue according to Chapman (1975) was used for the demonstration of general proteins. Periodic acid Schiff's reaction was used for the detection of general carbohydrates (Mc-Manus and Cason, 1950). Inner and outer coat fibers were taken in both seasons from left mid-side and at shearing time (one year growth) from right med-side. Fiber diameter (FD) was measured from samples using image analyzer (LEICA Q 500 MC) with lens 4/0.12. A section of 0.2 mm in length was cut by a Hand-Microtome at a level of 2cm from the base of the lock of each sample. These cuttings were put on a microscope slide with 2-3 drops of paraffin oil and covered with a slide cover. About five hundred fibers were measured from each sample. Medullated fibers percentage (M %) was recorded as a

percentage of medullated fibers from the corresponding total fibers used during measuring FD. Fiber length measured in 50 fibers of each sample using a ruler. Fiber scales characteristics measured using scan electron microscope. Data were analyzed with the general linear model (GLM) of SAS (2001). Comparisons among means within each classification were tested using Duncan's New Multiple Range Test.

## 3. Results and discussion

### Outer coat Fiber characteristics

In the present study during shearing time (one year of hair growth) fiber length of Shami goat's hair was 9.91 cm in average and reached17.5 cm in some animals. Mean fiber diameter was 63.22 µm with some fibers had 30 µm and others reached over 80µm.Helal et al (2010) reported that Baladi goats had harsher fibers (101 µm) than Shami goat (67.8µm). Medullated fibers represent50.2% of total fibers and medulla formed about 42.5 % of total fiber diameter. Figure (1) shows that fibers with 60 µm or les represent 49% of total fibers, while fibers more than 80 µm represent only 15% of total fibers. Fibers with diameter below 50 µm represent 31% of total fibers and this percent is too high and allude to the ability Shami hair to be added with wool blend to produce yarns.




Percentage over columns represents the percentage of each category from all frequencies.
Figure (1) Fiber diameter distribution of outer coat.

Figure (2) shows that outer coat fiber diameter increased 5.2 µmin summer compared with autumn season, which could be a good indicator to the higher fiber productivity during summer compared with autumn in outer coat fibers. Fibers used in the scan electron microscope showed that scale dimensions found to be 12.91 µm in long, 22.5 µmin widths, 0.35 µmin thicknesses, 0.42 µm in height and 72.11 µm in the total area (Image 1). Moreover, two to three scales needs to cover the fiber horizontal length (diameter).

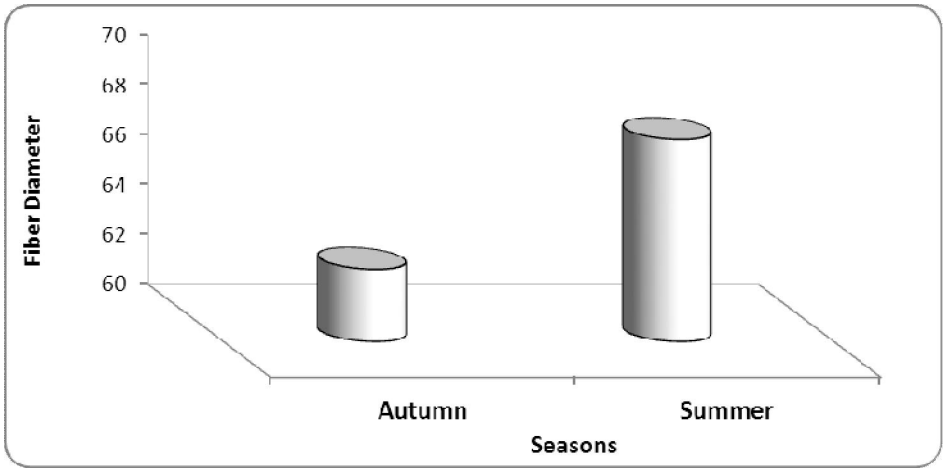



Figure (2) Average fiber diameter in both seasons.

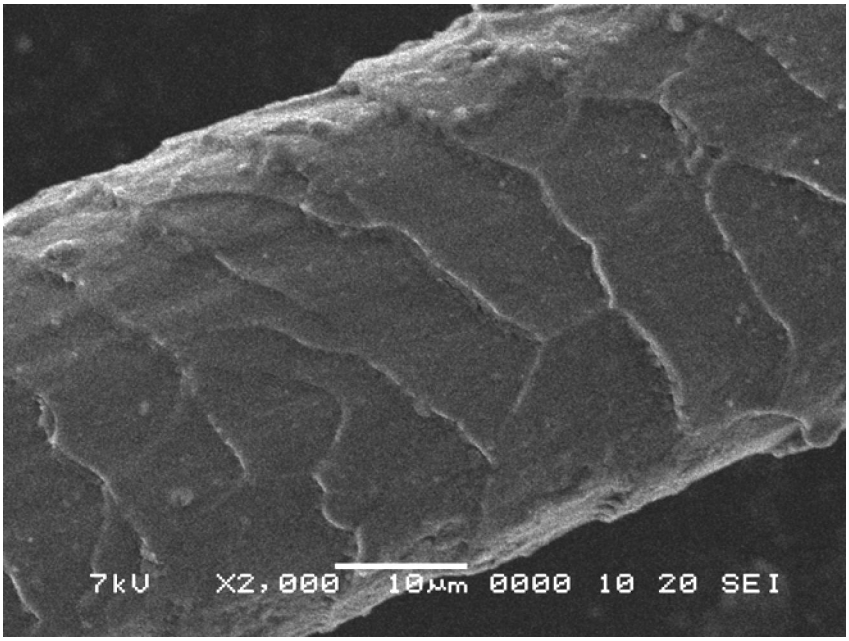



Image (1) scan electron microscope of outer coat fiber of Shami goats.

**Inner coat fiber characteristics**

Inner coat represent a small amount in autumn, while disappeared gradually during summer time. The same results found by Helal (2009), who reported that inner coat disappeared completely from May to June and started to appear in August and reached the maximum in January. Moreover, Mitchell et al (1992) reported that in Cashmere goat fiber growth increased from February to May for cashmere fibers, while guard hair increased from December to April. In the present work, inner fibers had 18 µm of average fiber diameter with average length of 0.86 cm at the end of autumn season.

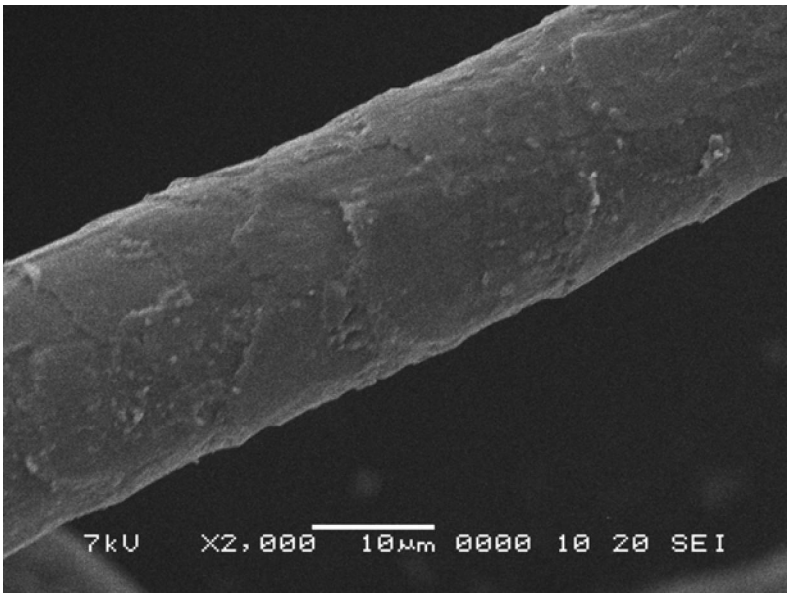



Image (2) Scan electron microscope of inner coat fiber of Shami goats.

**Histological and histochemical measurements**

All measurements of primary and secondary follicles were higher in summer compared with autumn as shown in Table (1).Many authors assume that decreasing day length in autumn provides suppression stimulation of wool follicle activity, while increasing day length in spring stimulates reactivation of follicles (Stewart et al 1961 and Rougeout 1961). Moreover,

Black and Reis (1979) stated that rate of wool production affected by photoperiod. Badawy, (2011) found that the external wool follicle diameters of the primary and secondary follicles affected significantly by seasons and it increased significantly in summer than in winter. In the present study, external diameter of primary follicles found to be higher 3.3 times as much as external diameter of secondary follicle in autumn and the same value found in summer, which is weird. That means both fibers increase in volume with similar proportion to each other in both studied seasons individually. The external diameter of primary follicles increased 1.7 times from autumn to summer and (once more) with similar value for external diameter of secondary follicles from autumn to summer. The previous results indicate that each follicle increased with the same ratio from autumn to summer. Similar ratios between external diameter of both follicles types to each other in the same season and the same ratio of each follicle type from autumn to summer reflect the harmony and symmetric relationship found between the volume of primary and secondary follicles. Data in Table (1) showed that fiber diameter of primary follicle increased 1.65 times from autumn to summer, while increased 1.39 times compared with secondary follicle. Previous results indicate that, in spite of the similar increase in the external diameter of both primary and secondary follicles from autumn to summer, fiber diameter in the primary follicle increased with higher ratio comparison with fiber diameter of secondary follicles. This variation in follicle fiber diameter could be related to the increase in wall thickness of primary follicles which was 1.16 times in summer compared with autumn, while it was 1.31 times in wall thickness of secondary fibers in summer compared with autumn.

Table (1). Follicles dimensions during the studied seasons

| Follicle type | Traits | Season | |
|---|---|---|---|
| | | Summer | Autumn |
| Primary follicles | External | 134.02±6.128 [a] | 78.41±2.921 [b] |
| | Internal | 112.23±5.426[a] | 59.74±2.587 [b] |
| | Wall Thickness | 21.79±2.048[a] | 18.67±0.976[b] |
| | Fiber | 47.49±2.221[a] | 28.71±1.059[b] |
| Secondary follicles | External | 40.22±1.041[a] | 23.78±0.853[b] |
| | Internal | 29.67±0.831[a] | 15.66±0.681[b] |
| | Wall Thickness | 10.55±0.460[a] | 8.12±0.377[b] |
| | Fiber | 8.95±0.472[a] | 6.43±0.387[b] |

Means with different superscript letters in the same row are differed significantly at P<0.05.

Highly and significant correlation found among external, internal and fiber diameter of primary follicle, which ranged from (r = 0.96) to(r=0.85), while wall thickness had less values of correlation with all follicle dimension (external, internal and fiber diameter) which ranged from (r = 0.47) to (r = 0.21). In secondary follicles, the highest correlation found between external and internal follicle diameter (r = 0.95), while the lowest significant correlation found between internal follicle diameter and wall thickness (Table2). Moreover, non-significant correlation found between fiber diameter and its wall thickness.

Table (2).Correlation among follicle features in both primary and secondary types

| | | Internal | Fiber | Wall Thickness |
|---|---|---|---|---|
| Primary follicle | External | 0.96** | 0.87** | 0.47** |
| | Internal | | 0.85** | 0.21* |
| | Fiber | | | 0.35** |
| Secondary follicle | External | 0.95** | 0.43** | 0.64** |
| | Internal | | 0.47** | 0.35** |
| | Fiber | | | 0.13[ns] |

** P < 0.01 * P < 0.05

Results from Table and Image (3) showed a significant increase of protein optical density in autumn compared with summer (0.72 vs. 0.68, respectively). Protein was higher in secondary follicle compared with

primary one (0.74 vs. 0.64, respectively). Protein was higher but insignificantly in outer root sheath compared with inner root sheath. In the same context, Parmar et al. (1988) found that protein amount in the outer root sheath was greater than that of the inner root sheath and this was probably due to increased protein synthesis during cellular proliferation. Hekal (1996) reported that concentration of NH2 groups in both primary and secondary fibers of Barki sheep is higher in winter than in summer. Also, seasonal variation is observed in tryptophan content, which is higher in winter than in summer (El–Ganaieny et al., 1998). The increase in protein of secondary follicle in autumn than summer could be related to the increase in secondary follicle fiber production to produce inner coat fibers. On the other hand increasing protein in secondary than primary follicles and in autumn than summer could be explained by follicle activity that when follicle was active it consumes more protein so stored protein tended to decrease and vice versa.

Carbohydrate followed the same trend of protein with season when it increased during autumn compared with summer, while no differences found between primary and secondary follicles. Carbohydrate increased significantly in outer root sheath compared with inner root sheath (0.51 vs. 0.46, respectively). Same result was found by Badawy (2011) who stated that in primary and secondary wool follicles the outer root sheath showed the highest content of general carbohydrate than the other follicle layers

Table (3).Means and standard errors of some factors affected on follicles histochemistry.

| Factors | | Protein | SE | Carbohydrate | SE |
|---|---|---|---|---|---|
| season | Autumn | 0.72[a] | 0.007 | 0.71[a] | 0.006 |
| | Summer | 0.68[b] | 0.006 | 0.21[b] | 0.006 |
| Follicle | Secondary | 0.74[a] | 0.007 | 0.48[a] | 0.006 |
| | Primary | 0.64[b] | 0.006 | 0.48[a] | 0.006 |
| layer | outer | 0.70[a] | 0.007 | 0.51[a] | 0.006 |
| | Inner | 0.69[a] | 0.007 | 0.46[b] | 0.006 |

In each category Means with different superscript letters of the same column are differed significantly at $P<0.05$.

In table (4) the interaction among seasons, follicle type and follicle layers showed that for protein optical density inner and outer root sheath differ significantly during autumn in both primary and secondary follicles, while during summer no significant differences between outer and inner root sheath were found in both primary and secondary follicles. The heist protein optical density was found in outer root sheath of secondary follicles during autumn, while the lowest one found in both outer and inner root sheath of primary follicles during summer. On the other hand, Badawy (2011) stated that general proteins as demonstrated by the bromophenol blue stain was more concentrated in inner and outer root sheaths of primary follicles in summer than in winter with reversible trend for secondary follicles. This might be probably due to the increased protein synthesis during cellular proliferation as shown by Parmar, et al. (1988).

Carbohydrate increased in inner and outer root sheath of primary follicles during autumn and in outer root sheath of secondary follicles during autumn (0.75 optical density for each). The lowest carbohydrate optical density found in inner root sheath of primary follicles during summer (0.17) followed by outer root sheath of primary follicles and inner root sheath of secondary follicles during summer (0.20). Badawy (2006) found that, in secondary follicles the outer root sheath showed great amount of carbohydrates in summer, while few amounts of carbohydrates were noticed in the inner root sheath of the secondary follicles in summer season (Image 4). Figure (3) showed that protein level found to be higher than carbohydrate level during summer and become almost equal during autumn. High level of protein found in both follicles and in both layers compared with carbohydrate level. Carbohydrate found to be higher in outer root sheath compared with inner root sheath. Ryder (1958) stated that glycogen is stored in the follicle outer root sheath and as long as hair is growing there is glycogen in the follicle and once the follicle is mature it can store glycogen and a poor diet can't completely prevent hair growth, but it can slow it down. Moreover, glucose provides energy and playing as precursor in amino acids synthesis as well as important in the synthesis of Ribose to form a part of RNA and DNA molecules (Leng and Stephenson, 1965).Acetate also acts as precursor for amino acids and glycogen has been demonstrated to be present in wool fiber root (Ryder 1958 b).In goat a strong activity for acid Mucopolysaccharide was observed in the outer root sheath (Parmar et al 1988).

Table (4). Means and standard errors of histochemical parameter of primary and secondary follicle during studied seasons.

| Season | Follicle | Layer | Protein | SE | Carbohydrate | SE |
|---|---|---|---|---|---|---|
| Autumn | Primary | Inner | 0.68[a] | 0.014 | 0.75[a] | 0.240 |
| Autumn | Primary | outer | 0.72[bd] | 0.014 | 0.75[a] | 0.196 |
| Autumn | Secondary | Inner | 0.71[ad] | 0.014 | 0.62[c] | 0.169 |
| Autumn | Secondary | outer | 0.76[b] | 0.014 | 0.75[a] | 0.210 |
| Summer | Primary | Inner | 0.59[c] | 0.013 | 0.17[b] | 0.069 |
| Summer | Primary | outer | 0.59[c] | 0.013 | 0.20[be] | 0.091 |
| Summer | Secondary | Inner | 0.75[b] | 0.012 | 0.20[e] | 0.081 |
| Summer | Secondary | outer | 0.73[bd] | 0.012 | 0.25[d] | 0.111 |

Means with different superscript letters in the same column are differed significantly at P<0.05.

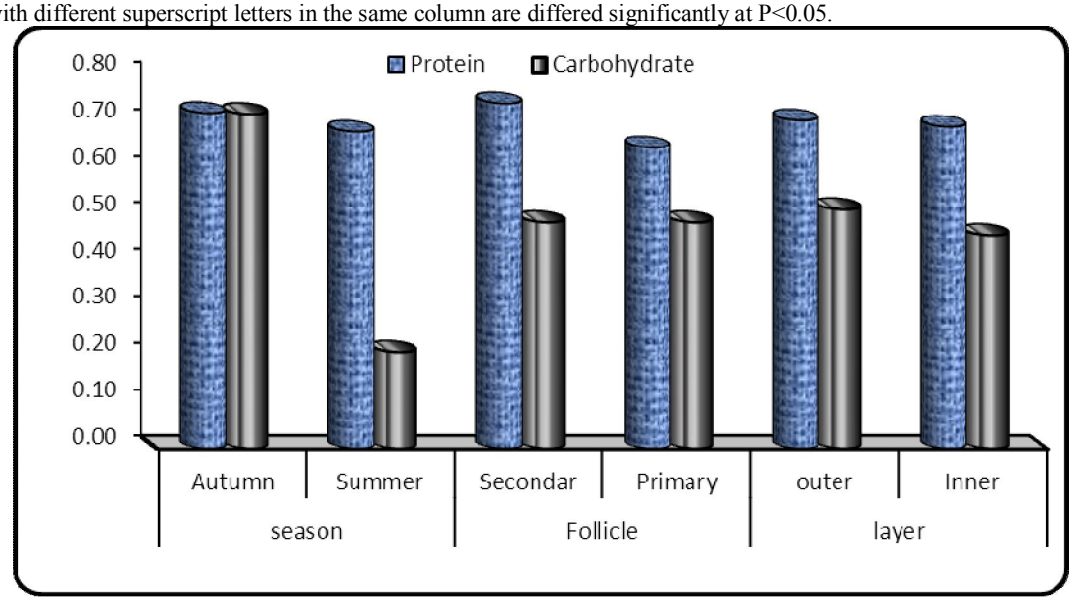
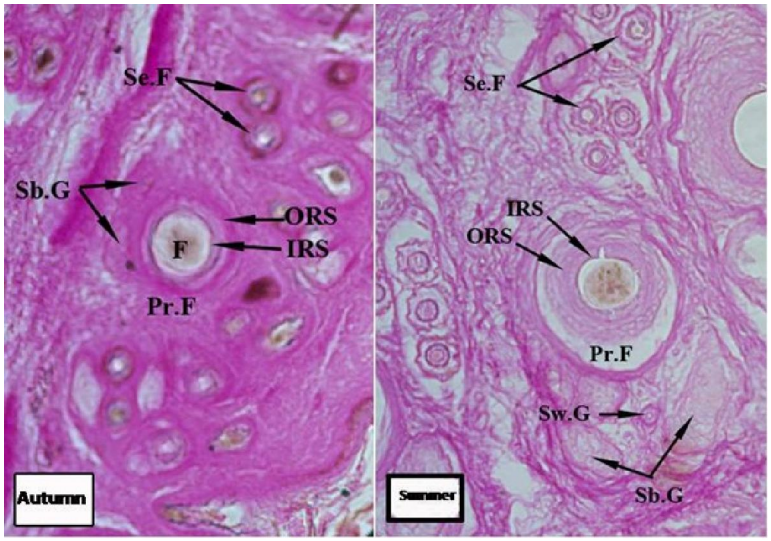
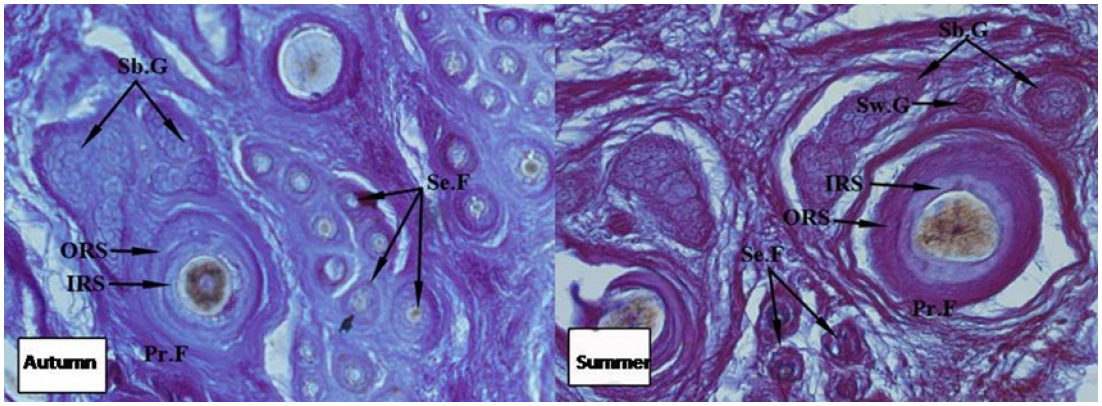



Figure (3) Average protein and carbohydrate level between seasons, follicle types and follicle layers.




Sb.G = Sebaceous gland, Sw.G = Sweat gland, Pr.F = Primary follicle, Se.F = Secondary follicles, IRS = Inner root sheath and ORS = outer root sheath

Image (3) General Protein of Shami goat's follicles in both studied seasons.




Sb.G = Sebaceous gland, Sw.G = Sweat gland, Pr.F = Primary follicle, Se.F = Secondary follicles, IRS = Inner root sheath and ORS = outer root sheath

Image (4) General carbohydrate of Shami goat's follicles in both studied seasons.

**Acknowledgment**

This work was supported by the United State–Egypt Joint Science and Technology Fund Program, Under Project Number BIO11-001-005.

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8/8/2014