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# A STUDY OF SHEEP BREED DIFFERENCES IN UTILIZING FEED HIGH IN WHEAT STRAW[1,2]

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**Abstract** — Thirty ewe lambs, consisting of 10 Karakul (range sheep), 10 Mehraban (farm sheep), 10 Targhee X Mehraban crossbreds and also 20 mature ewes (Karakul and Mehraban) were used to study the effect of genotype on the intake of high wheat straw feeds and gain using two different rations. Eighteen ram lambs of the three above mentioned breeding groups were also used to estimate digestibility of the feeds.

Ration 1 was composed of 60% alfalfa hay, 20% wheat straw and 20% concentrate. Ration 2 was composed of 20% alfalfa, 60% wheat straw and 20% concentrate ($TDN/_{DP}$ of the two rations were similar). The experiments were conducted in three seasons; fall, winter and spring each for a period of 30 days.

Targhee X Mehraban and Mehraban breeding groups generally had higher feed intake, higher gain and higher digestibility than Karakul, but the differences were not significant except for feed intake during the fall trial. There was no evidence to indicate that the ration high in alfalfa was utilized more efficiently than the ration high in wheat straw. The ration high in alfalfa was more palatable and was consumed more readily resulting in greater gain compared with gains on the other ration. Generally no significant breed, season or ration differences were observed for the digestibility of dry matter, protein, fat and crude fiber, except for protein of the ration high in alfalfa which was more digestible than that of the ration high in wheat straw.

## INTRODUCTION

A considerable portion of the natural ranges of Iran has been ploughed for crop production in recent years. Unfortunately, efforts for range improvement through range reseeding have not been very successful. The development of arid pastures is difficult due to low precipitation and long dry seasons, overgrazing and also a lack of sufficient experience in this field. The development of irrigated pastures may not be economical,

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compared with crop production. On the other hand a relatively large amount of wheat straw is produced annually, which if utilized properly, would compensate for the shortage of natural ranges substantially.

The potential of different breeds of sheep in efficient utilization of high fiber feeds such as wheat straw may be different. Therefore, under the above conditions it would be more economical to raise the breeds with high potential for efficient utilization of high fiber feeds.

The objectives of this study were:

(1) To compare two distinct native breeds of sheep (Karakul as a range sheep and Mehraban as a farm sheep) for their efficiency in consuming a high amount of wheat straw.

(2) To study the potential of crossbred sheep (Targhee X Mehraban) for efficient utilization of rations containing a high amount of wheat straw.

## MATERIALS AND METHODS

*Feeding trials*

Two rations, one high in alfalfa and the other high in wheat straw, were compared for their effects on feed intake and live-body weight changes in 3 different seasons, using 30 ewe lambs and 20 mature ewes. The lambs consisted of 10 Karakul, 10 Mehraban and 10 crossbred lambs obtained by crossing Targhee rams with Mehraban ewes. Karakul is a fat-tailed range sheep and managed mostly under a migratory system while Mehraban is a fat-tailed farm sheep.

The lambs used in this study were born as singles in 1975 at the Animal Experiment Station of the University. The lambs were creep fed and weaned at 75 ± 5 days of age. After weaning, the lambs were grazed on farm residues (mostly wheat and barley stubbles) during the summer months. The lambs were supplemented with 100 g barley and 250 g alfalfa hay per head per day.

The mature ewes were of Karakul and Mehraban breeds and were used as a control group during the 3 seasons. They had been managed under farm conditions at the Animal Experiment Station.

The ingredient composition and chemical composition of the experimental rations are given in Table 1. The first ration consisted of 60% alfalfa hay, 20% wheat straw and 20% concentrate whereas the second ration consisted of 60% wheat straw, 20% alfalfa and 20% concentrate. The concentrate was composed of barley and cotton seed meal in different ratios for the two rations. The alfalfa was sun-cured after cutting at about 30–40% in bloom. Cotton-seed meal was included in the ration containing a high amount of wheat straw to balance the $TDN/_{DP}$ in the two rations. The ingredients were ground and mixed properly.

The first stage of the experiment started in September 1975 for a 30-day period (the fall experiment). The lambs and ewes were randomly chosen from the flock and allocated to one of the experimental rations and fed *ad libitum* in individual boxes. Dry sheep manure was used as bedding. Water and rock salt were available at all times. The animals were fed four-times daily and the refused feed was collected before the first feeding every day. The initial weight, body weight after 30 days and feed intake were recorded. The animals were returned to the main flock after this stage and the same animals were

reallocated randomly to the same rations in December 1975 (the winter experiments) and in March 1976 (the spring experiment) for 30 days each. The average age of the lambs was 6, 10 and 14 months at the beginning of the fall, winter and spring experiments, respectively.

Table 1. Ingredient composition and chemical composition of the experimental rations

| Ingredient composition, % | Ration 1 | Ration 2 |
|---|---|---|
| Alfalfa | 60 | 20 |
| Wheat straw | 20 | 60 |
| Barley | 20 | 3 |
| Cotton seed meal | – | 17 |
| Chemical composition*, % | | |
| Crude protein | 12.6 | 13.1 |
| Ether extract | 1.7 | 1.4 |
| Crude fiber | 21.8 | 24.6 |
| Ash | 8.8 | 9.5 |
| Dry matter | 89.4 | 89.9 |

*90% dry matter basis.

*Digestion trials*

The same rations were fed to 18 ram lambs composed of 6 Karakul, 6 Mehraban and 6 Targhee X Mehraban crossbred groups. Pre-weaning and post-weaning feeding and management of the ram lambs were similar to that of ewe lambs. They were placed in individual boxes for a 7 day preliminary and 7 day digestion trial during which faeces were collected and sampled. Digestion trials were started with the feeding test. The age of the ram lambs and ewe lambs was approximately equal.

*Analysis of data*

One of the ewes in the feeding trial and one of the rams in the digestion trial were off-fed during the fall experiment and therefore were excluded from the experiment. Due to unequal number of observations in different subclasses the data were analyzed by the least-squares procedure [7].

The daily feed intake and body weight changes of the ewes were analyzed by using a model in which constants were fitted for breed, ration, season and all the two factor interactions. The initial weight of the animals was considered as a covariable in the model. Since season had a significant effect on the traits, the data on ewe lambs were analyzed within each season. For each season, constants were fitted for breed, ration and breed X ration interaction, while initial weight was considered as a covariable. Since age of lamb was confounded with season, comparison was not made for the effect of age.

For the digestibility trials, constants were fitted for the effect of breed, ration, season and all possible two-way interactions. Since the effect of season on digestibility was negligible, it was deleted from the model and the data were re-analyzed.

Table 2. Analysis of variance of feeding trial records of ewes

| Source of variation | d.f. | Mean squares | |
|---|---|---|---|
| | | Daily feed intake | Body weight change |
| Breed (B) | 1 | 912.0 | 3174.2 |
| Ration (R) | 1 | 2418992.0† | 46585.5* |
| Season (S) | 2 | 1236008.0† | 46909.0* |
| B X R interaction | 1 | 362864.0 | 4522.4 |
| B X S interaction | 2 | 149576.0 | 20203.6 |
| B X S interaction | 2 | 123776.0 | 10404.6 |
| Regression of traits on initial weight | 1 | 50720.0 | 1065.7 |
| Error | 48 | 148308.3 | 6495.2 |

*Significant at $p<0.05$.

†Significant at $p<0.01$.

Table 3. Least-squares constants and standard errors for the ewe feeding trials and test of significance for differences between constants

| Main factors | Sub-class | No. of ewes | Daily feed intake (g) | Daily body weight change (g) |
|---|---|---|---|---|
| Overall mean | | 59 | 1655.3 ± 49.9 | 112.3 ± 10.4 |
| Breed | Karakul | 29 | 4.0 ± 51.6a* | −7.5 ± 10.8a |
| | Mehraban | 30 | −4.0 ± 51.6a | 7.5 ± 10.8a |
| Ration | High alfalfa | 29 | 204.2 ± 51.6a | 28.3 ± 10.8a |
| | High wheat straw | 30 | −204.2 ± 51.6b | −28.3 ± 10.8b |
| Season | Fall | 19 | 258.4 ± 83.3a | 52.9 ± 17.4a |
| | Winter | 20 | 81.2 ± 71.2a | 12.3 ± 14.9a |
| | Spring | 20 | −339.6 ± 74.4b | −65.3 ± 17.4b |
| Regression on initial weight | | | 4.7 | 0.7 |

*All means within a particular sub-class differ significantly ($p<0.05$) except those followed by the same letter.

## RESULTS AND DISCUSSION

### *Breed*

The analyses of variance for daily feed intake and live body weight changes of ewes are given in Table 2 and the appropriate least-squares constants are presented in Table 3. The breed of ewe did not have a significant effect on the traits studied. None of the two-way interactions had any significant influence on the traits studied.

Table 4. Least-squares constants and standard errors for lamb feeding trials and test of significance for differences between constants

| Classification | Feed intake | | | Daily gain | | |
|---|---|---|---|---|---|---|
| | Fall | Winter | Spring | Fall | Winter | Spring |
| Overall mean | 911.8 ± 23.9 | 1440.0 ± 25.4 | 1282.4 ± 34.3 | 64.1 ± 7.5 | 154.0 ± 5.8 | 142.9 ± 13.3 |
| Breed: | * | | | | | |
| Karakul | −115.4 ± 41.2a† | −22.5 ± 49.2a | −23.6 ± 59.6a | −19.0 ± 13.2a | −25.3 ± 11.3a | −13.8 ± 24.8a |
| Mehraban | 13.1 ± 34.9ab | 12.2 ± 35.8a | 25.2 ± 46.9a | −1.2 ± 11.2a | 3.9 ± 8.3a | 12.3 ± 19.5a |
| Targhee X Mehraban | 102.3 ± 36.6b | 10.3 ± 45.8a | −1.6 ± 54.4a | 20.2 ± 11.8a | 21.4 ± 10.6a | 1.5 ± 22.7a |
| Ration: | ** | ** | ** | | ** | |
| High alfalfa | 99.5 ± 24.8a | 131.9 ± 26.2a | 121.4 ± 32.9a | 5.8 ± 8.0a | 31.3 ± 6.0a | 24.6 ± 13.7a |
| High wheat straw | −99.5 ± 24.8b | −131.9 ± 26.2b | −121.4 ± 32.9b | −5.8 ± 8.0a | −31.3 ± 6.0b | −24.6 ± 13.7a |
| Regression of traits on initial weight | 34.7** | 25.3* | 17.9 | 1.1 | −2.6 | 0.4 |

*Significant at $p<0.05$.

**Significant at $p<0.01$.

† All means within a particular sub-class differ significantly ($p<0.05$) except those followed by the same letter.

Least-squares constants for the lamb feeding trial in the three seasons are presented in Table 4. No significant breed differences were observed except for the amount of feed intake in the fall. The Targhee X Mehraban crossbred group had significantly higher feed intake in the fall than the Karakul group. The interaction between breed and ration was not a significant source of variation. Least-squares means for per cent digestibility of the different feed components are given in Table 5. Breed and breed X ration interaction did not have a significant effect on digestibility.

Table 5. Least-squares means and standard errors of per cent digestibility and test of significance for differences between means

| Classification | Dry matter (%) | Crude protein (%) | Ether extract (%) | Crude fiber (%) |
|---|---|---|---|---|
| Overall mean | 53.4 ± 1.9 | 64.9 ± 2.1 | 43.4 ± 2.9 | 39.1 ± 3.0 |
| Breed: | | | | |
| Karakul | 51.3 ± 3.7a* | 62.2 ± 2.6a | 40.8 ± 3.4a | 36.6 ± 3.7a |
| Mehraban | 53.2 ± 3.9a | 64.2 ± 2.8a | 43.1 ± 3.8a | 37.6 ± 4.0a |
| Targhee X Mehraban | 55.6 ± 3.7a | 68.1 ± 2.6a | 46.3 ± 3.4a | 41.1 ± 3.7a |
| Ration: | | | | |
| High alfalfa | 56.8 ± 3.2a | 67.4 ± 2.4a | 46.8 ± 3.8a | 40.4 ± 3.4a |
| High wheat straw | 50.1 ± 3.2a | 62.5 ± 2.4b | 40.1 ± 3.8a | 37.8 ± 3.4a |

*All means within a particular sub-class differ significantly ($p<0.05$) except those followed by the same letter.

The Karakul breed is originally a range sheep and well adapted for utilizing low quality feed under adverse environmental conditions in Iran. The Mehraban, on the other hand, is a farm sheep and has been raised under better environmental conditions than the Karakul. In the lamb feeding trial, the feed intake and change in body weight of the two were similar under the two different rations. Mehraban ewes are somewhat heavier than Karakuls at maturity, but in this experiment, feed intake and body gain records were analyzed on the basis of equal weight by including the regression of the traits on initial weight in the mathematical models. It can, therefore, be concluded that the efficiency of cellulose utilization is the same for the two breeds, although they were originally raised under different management and nutritional conditions. The analysis also indicated that the effects of breed X season and breed X ration interactions on feed intake and gain were not significant, indicating that the response of the two breeds does not change as a result of differences in season or ration. It must be noted that all the ewes used in this experiment were managed under farm conditions for at least three years.

Although it was expected that a native range sheep, such as Karakul, would consume more of the ration high in wheat straw than the farm breeds, nevertheless, the results of this experiment showed that both Mehraban and Targhee X Mehraban generally performed better than Karakul as far as feed consumption, gain and efficiency of feed

utilization were concerned. However the differences were not significant except for feed intake in the fall. It may be concluded that, due to the continuous feed insufficiency of the Karakul on poor ranges, nature has selected the animals which can live and reproduce on a very small amount of feed, gradually losing the ability to consume a great amount of feed.

O'Donovan and Ghadaki [10], in a digestion trial with the fat-tailed Iranian breeds of sheep, reported 58 and 60.6% digestibility for dry matter and protein, respectively, in an all wheat straw ration and concluded that the coefficients were higher than those generally found for wheat straw. They attributed the results to the more efficient utilization of fiber by the native breeds which is in contrast with the results obtained in this study. Raton *et al.* [11] reported that the digestibility of crude protein was significantly higher in Indian Marwari sheep than in the Russian Merino X Marwari crossbred sheep with considerably better yield and quality of fleece when low quality roughage was fed alone. Dry matter digestibility was also higher in pure Marwari sheep compared with the crossbreds.

Previous studies indicated the superiority of Targhee X Mehraban lambs over Karakul lambs for pre-weaning growth, feedlot gain and feed efficiency [8]. Farid *et al.* [5] and Makarechian *et al.* [9] reported the superiority of Mehraban over Karakul lambs for the above mentioned traits. The results of the present study indicate that the three breeding groups could be ranked in the same order as their rate of growth for the low quality roughage utilization when fed with enough protein supplement.

*Ration*

There was a significant difference between the two rations both for feed intake and change in body weight of the mature ewes (Table 3). The animals on the ration containing a high amount of alfalfa, on the average, consumed 408 g more feed and gained 57 g per day more.

Ewe lambs receiving the ration high in alfalfa consumed more feed than the animals receiving the ration high in wheat straw ($p < 0.01$). The lambs on the former ration gained more in the three experiments, but the difference was significant only in the winter experiment. The rations were similar for the per cent digestibility of all the major components except crude protein, which was higher for the ration high in alfalfa than for the other ration.

Although the animals receiving the high alfalfa ration consumed significantly more feed than the other group, the high feed intake did not correspond with high feed efficiency in all the cases. In the case of ewes, each 7.3 kg extra feed intake produced 1 kg gain, which is an average feed efficiency figure for mature ewes. In the case of lambs, feed efficiency varied greatly. Each extra unit of gain by lambs was produced by 16.0, 4.2 and 4.9 extra unit of feed during the fall, winter and spring feeding trials, respectively. It must be pointed out that the conditions of the animals before entering the feeding trial in each season have had a great influence on their performance and, consequently, on feed efficiency in that particular trial.

Therefore, while definite conclusions can not be drawn from the feed efficiency of the animals under the two rations, it seems safe to conclude that both palatability and better feed utilization have contributed to the higher feed consumption of the animals receiving the high alfalfa ration.

O'Donovan and Ghadaki [10], in their experiments with some Iranian fat-tailed sheep,

reported that the addition of 30% wheat straw to the fattening ration lowered feed intake, gain and feed efficiency. In their experiment, wheat straw was not ground as was the case in our experiment, which would affect digestibility and palatability [12].

Several studies [2, 3, 4, 6, 10] have shown that supplementing a low quality roughage with a high protein concentrate would increase feed intake and improve efficiency as a result of raising the protein level of the ration.

Finally, it can be concluded that a high amount of wheat straw is not a proper ration for fattening lambs, because it would generally increase the fattening period; but it would provide proper roughage for ewe flocks if fed with a protein supplement.

*Season*

Season significantly influenced feed intake and body weight (Tables 2 and 3). Feed intake and body-weight changes of the ewes did not differ significantly during the fall and winter experiments, but the animals consumed significantly less feed, and gained less during the spring trial, as compared with the two previous seasons.

In this experiment, the ewes were used as a control group to study the effect of season on the traits. The analysis of the data indicated that season had a significant effect on feed intake and change in body weight. One of the important contributing factors to the difference between the seasons might be the differences between the levels of nutrition of the ewes prior to the feeding trial in each season. During the fall and summer, the level of nutrition of the main flock was lower than the level of nutrition during the winter season when most of the ewes were either in late pregnancy or early lactation stage and required more feed. Therefore, the experimental ewes were thinner entering the fall and winter feeding trials compared with the conditions of the ewes entering the spring feeding trial. Therefore, feed intake and gain were greater in the fall and winter trials than those of the spring trial. Allden and Young [1] reported significantly greater herbage intake by the undernourished sheep when placed on pasture.

Although the effect of temperature on feed intake and gain should not be neglected, it can not be considered as an important source of variation. The difference in average temperature of early fall and early spring in Shiraz during which the first and the last feeding trials were performed was relatively small, but the ewes had higher intake and higher gain in the fall trial as compared with the spring trial.

Pre-experimental nutritional condition, age and season did not influence the coefficients of digestibilities significantly. The results are in agreement with those reported by Allden and Young [1] who found that pre-experimental feeding regime did not have an important effect on roughage digestibility in sheep.

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