FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS OF LOCAL (DHOFARI) AND EXOTIC (CASHMERE) GOATS FED ON A HIGH-FIBER BY-PRODUCTS DIET SUPPLEMENTED WITH FISH SARDINE

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Summary

In the first of two experiments, liveweight gain responses and carcass characteristics were investigated using two breeds of growing male goats, local (Dhofari) and exotic (Cashmere), fed on a whole pelleted-high fiber date by-products' based diet at 32.5% level (As-fed) supplemented with 12% fish (sardine), (HF-Fish) and a commercial concentrate diet (conc.). The (HF-Fish) diet was formulated to be iso-nitrogenous to the (conc.) diet, supplying 14% CP (DM-basis). Both diets together with Rhodes grass hay (Chloris guyana) were fed *ad libitum*. The experimental design was a complete random arranged in a 2 × 2 factorial with breeds and diets as the main factors, using six animals per treatment. The experiment lasted for 84 days and goats were penned individually. At the end of the feeding trial, three animals from each treatment group were slaughtered for carcass evaluation. In experiment 2, diets' digestibility and N-balance were determined using 3 sheep per diet. The (HF-Fish) diet significantly ($p < 0.05$) improved liveweight gain. There was also a significant difference ($p < 0.01$) between breeds, with Cashmere gaining more than local goats. Feed conversion efficiency, dressing percent and longissimus dorsi area were not significantly affected by diet or breed ($p > 0.05$). Digestibility of the proximate components and N-balance for both diets were similar and not significantly different ($p > 0.05$). Fish supplementation greatly improved the digestibility of CF, ADF, NDF, cellulose and hemicellulose. Meat production cost was decreased by 31% due to feeding of the (HF-Fish) diet.

(**Key Words**: High-Fiber, Fish, Concentrate, Goats, Carcass, Digestibility)

Introduction

Animal feed shortage is considered to be the single most important constraint to livestock development in the Sultanate (El Hag and El Khanjeri, 1992). Natural pasture and range constitute the major feed resources in addition to some imported raw feed ingredients which are processed locally into concentrates. Few irrigated forages such as alfalfa and Rhodes grass are also used for ruminants feeding in the country. However, drought, salinity and problems of overgrazing are seriously affecting the productivity of both irrigated forages and natural pastures and range. Fortunately there are many non-conventional feeds and by-products which constitute a cheap potential animal feed resource which if effectively utilized could improve the supply of animals feeds. The most important and available by-products in the Sultanate include those of dates such as: rejected dates (inferior quality dates not suitable for human consumption); date pits (pips); date syrup "Dibis"; date syrup by-product (DSBP, which is a local by-product resulting from production of syrup from dates. It contains unextracted sugars, fiber and date pits); date leaves "Khos" and date leaves + rachis (fronds). Fish (sardine) is also available in huge quantities and is traditionally used for feeding ruminants and also as a fertilizer. Estimated amounts of annual sardine catch was about 25,000 tons. The estimated amounts of dry matter annually resulting from pruning of date leaves + rachis, from date trees in the Sultanate was about 30,000 tons of DM (El Hag, 1995). By-products of dates such as leaves alone, leaves + rachis were found to be fibrous and deficient in protein and soluble carbohydrates (El Hag, 1995). DSBP was found to be a

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good and cheap energy source. Fish (sardine) was an excellent protein and minerals source. It contained more than 60% CP; about 4.3% Ca and 1.0% P (El Hag, 1995). Complete ruminant diets containing variable levels of date by-products supplemented with fish (sardine) were formulated for sheep and cattle. However, the feeding value of whole pelleted date by-products diets supplemented with fish for growing local (Dhofari) goats was not evaluated before. Performance of local (Dhofari) goats was always thought to be inferior to exotic goats and has never been seriously evaluated compared to exotic breeds as regard to its efficiency of feed conversion, growth and carcass quality.

The objectives of this research were:

1 - To formulate a complete ration utilizing local date by-products supplemented with fish (sardine) for growing goats mainly to promote utilization of cheap local feed resources and to decrease cost of feeding

2 - To evaluate feedlot performance and carcass characteristics of growing local (Dhofari) and exotic (Cashmere) goats fed on by-products and concentrate based diets.

Materials and Methods

Treatments :

The treatments evaluated in both experiments consisted of two diets, a high-fiber date by-products' based diet supplemented with fish (sardine) at 12% level (HF-Fish), test diet and a concentrate (conc.) commercial control diet manufactured by Oman Flour Mill (OFM), traditionally used for feeding ruminants in the Sultanate. The (HF-Fish) test diet was prepared in the Station. The diet was prepared by chopping the date leaves + rachis (DL + R), prior to grinding. The whole sun-dried (DL + R) was chopped into small particles utilizing a heavy duty chopping machine known as "620 Brush Chipper" manufactured by Vermer Co., Pella, Iowa, USA. The machine was basically designed to cut trees and wood. The chopped (DL + R) was then ground by a hammer mill, model "Super vac" 202/15E" manufactured by Alvan Blanch, England. The material was ground to a particle size of 2 mm prior to mixing. Fish (sardine) was purchased in a dry form (90% DM) and also ground to particle size of 2 mm with hammer mill. DSBP was purchased from a local Date-syrup processing plant, in a relatively moist form (<60% DM). The material was first sun-dried, by direct exposure to the sun using a plastic sheet and manually turned for seven days, to a dry matter of about (84%). The sun-dried (DSBP) was then ground also to a particle size of 2 mm, using the Super vac hammer mill. Barley grains were purchased in the ground form from (OFM). The different ground feed ingredients (DL + R, Fish, DSBP, Barley and salt) were then mixed together in the same proportions listed in table 1. The ingredients were mixed using a feed mixer manufactured by Alvan Blanch (model M 65 High speed). The capacity of the mixer was 965 kg/hr. The feed ingredients were mixed in batches of 500 kg/batch for 45 minutes (mixing time). The mixed (HF-Fish) diet was then pelleted to pellets of 8 mm (diameter of the pellet) using a pelleting machine also manufactured by Alvan Blanch. The capacity of the pelleting machine was 300 kg/hr. The commercial (conc.) control diet was directly purchased from (OFM) also having the same pellet size as the (HF-Fish) diet. Composition of both diets is shown in table 1.

TABLE 1. INGREDIENT PROPORTIONS (PERCENTAGE) IN EXPERIMENTAL DIETS (AS-FED)

Ingredients	Diet	
	(HF-Fish)	Conc.*
Date leaves + rachis	25	–
Date syrup by-product (DSBP)	7.5	–
Fish (sardine)	12	–
Barley	55	34.4
Salt	0.5	0.435
Maize grain	–	20.35
Ground oats	–	14
Rice bran	–	15
Soyabean meal	–	11.95
Lime stone	–	2.585
Sodium bicarbonate	–	0.3
Dicalcium phosphate	–	0.57
Vitamins and trace minerals	–	0.41
Premix	–	–
Total	100	100

* This was a commercial concentrate diet, manufactured by Oman Flour Mill for feeding ruminants. It contained 14% CP.

Animals and experimental design :

Experiment I

Twelve growing local (Dhofari) goats of 6-15 months old and mean body weight of 13.0 ± 1.1 kg and twelve growing exotic (Cashmere) goats of 10-18 months age and mean body weight of 33.6 ± 2.0 kg were used in this study. Both breeds of goats were divided into two groups of six animals per group, according to body weight. Mean initial body weights of the different groups for the local and Cashmere goats, respectively were: 12.9 ± 1.0 kg; 13.0 ± 2.0 kg and 33.6 ± 3.0 kg; 33.5 ± 2.8 kg.

The two diets were randomly allocated to the two groups of animals within each breed. The experimental design was essentially a complete random design arranged in a 2 × 2 factorial, with two breeds and two diets as the main factors, using six animals per treatment. Animals were individually housed in pens equipped with facilities for feed and water. In addition to the two diets, Rhodes grass hay was also fed to each animal in a separate feed trough. All the feeds were fed *ad libitum*. Animals were allowed free access to trace-mineralized salt lick blocks and clean water throughout the length of the trial which lasted for 84 days. Intake of feeds was recorded every day at 08:00 AM, refusals were measured and refed the following day. The animals were weighed every two weeks, with feed and water being removed the night preceeding weighing. Immediately after the termination of the feeding trial, three animals from each treatment were slaughtered for carcass analysis. The animals were selected representing the heaviest, medium and lightest individuals within each treatment group. The animals were slaughtered according to Muslim (Halal) tradition. Non-carcass components: head, skin, feet, omental fat, full and empty alimentary tract, liver, spleen, lungs and trachea, heart, genitals, kidneys and kidney fat were weighed to the nearest g. Dressed carcasses were weighed, chilled for 24 hrs at 4℃, then each carcass was split along the vertebral column into left and right halves using a saw. The left side was used for measurement of the longissimus dorsi area "between the 12th and 13th ribs". Weight of gut contents at slaughter (gut fill) was calculated by difference between full and empty alimentary tract, and empty body weight was computed by subtracting the weight of gut contents from slaughter weight. Carcass data were analysed as a 2 × 2 × 3 factorial according to Steel and Torrie (1980).

Experiment Ⅱ

As goats were difficult to handle and keep in metabolism cages and since sheep were more docile and easy to handle, it was decided to measure the nutritive values "*In vivo*" digestibility, total digestible nutrients and nitrogen-balance" of the diets using sheep instead of goats.

In this experiment six local mature Omani sheep, about three years old, were used (with 3 animals/diet) in a digestibility and N-balance trial. Sheep were allowed seven days preliminary period and five days collection period, with the diets offered free choice.

Measurements and laboratory analysis : Experiment Ⅰ and Ⅱ

During the feeding trial (experiment Ⅰ), feed samples from the (HF-Fish), conc. and Rhodes grass hay were collected and analysed every two weeks for proximate analysis, according to AOAC (1984). Cell wall constituents and lignin were analysed according to Goering and Van Soest (1970). In experiment Ⅱ, during the collection period, the amounts of feeds offered, refused, faeces and urine output were daily recorded for each animal. Urine sub-samples of about 10% of the volume of urine excreted for each animal were bulked in a bottle after the addition of one drop of conc. H_2SO_4 to trap ammonia. The bulked urine samples for each animal were analysed for nitrogen using micro-kjeldahl (AOAC, 1984). Sub-samples of faeces for each animal were bulked together after oven-drying at 105℃ for 8 hrs. The dried faecal samples were ground to pass a 1.0 mm sieve and analysed for proximate components, according to AOAC (1984). Cell wall constituents in faecal samples were analysed according to Goering and Van Soest (1970). The digestibility coefficients for the proximate components and cell wall constituents and N-balance data were analysed as a complete random design (2 × 3), with two diets and 3 animals/diet, according to Steel and Torrie (1980).

Results and Discussion

The ingredient proportions (composition) of the two diets used in this study are shown in table 1. It was obvious that the commercial conc. diet was based mainly on cereal grains (barley, maize and oats) and its protein fraction was supplied mainly from plant proteins, unlike the (HF-Fish) diet which contained both plant and animal (fish) proteins. The (HF-Fish) diet also contained high roughage- supplying ingredients (date by-products).

Chemical composition of the dietary ingredients used in formulating the (HF-Fish) diet and the composition of the experimental diets are presented in table 2. It was clear that (DL + R) was a fibrous material and it contained low CP, where as (DSBP) was very similar in its carbohydrate fraction (NFE + CF) to barley. However, (DSBP) had a low CP content, compared to barley. Fish (sardines) was rich in CP and also rich in its total ash content. Both (HF-Fish) and conc. diets were almost iso-nitrogenous and also isocaloric, however the (HF-Fish) diet was rich in its fiber fraction (CF, NDF, ADF and cellulose) compared to the conc. diet. It is interesting to note that Rhodes grass hay was somewhat comparable to date leaves + rachis, particularly in its carbohydrate fraction and cell wall constituents (NDF, ADF and cellulose). However, date leaves + rachis was more lignified and it contained less energy and protein than

TABLE 2. CHEMICAL COMPOSITION OF DIETARY INGREDIENTS USED IN FORMULATING THE TEST (HF-FISH) DIET AND OF EXPERIMENTAL DIETS (PERCENTAGE DRY MATTER-BASIS).

Item	Ingredients/Diet						
	Date leaves + rachis	DSBP	Fish sardine	Barley	HF-Fish diet	Conc. diet	Rhodes grass hay
Dry matter (DM)	89.8	84.0	90.0	89.5	90.0	89.0	89.7
Crude protein (CP)	2.8	5.6	60.0	10.8	14.4	14.0	8.6
Crude fiber (CF)	42.0	12.4	zero	5.3	12.6	8.8	31.6
Ether extract (EE)	0.8	3.4	3.2	2.0	1.9	3.0	1.2
Ash	9.4	3.0	30.0	2.2	7.4	9.2	9.2
Nitrogen free extract (NFE)	45.0	75.6	6.8	79.7	63.7	65.0	49.4
Neutral detergent fiber (NDF)	61.0	55.0	–	29.3	30.4	23.0	74.0
Acid detergent fiber (ADF)	55.4	48.7	–	6.4	18.8	9.5	46.7
Cellulose	36.3	21.0	–	5.3	16.0	7.3	33.7
Hemicellulose	5.6	6.3	–	22.9	11.6	13.5	27.3
Lignin	12.0	5.5	–	1.0	2.8	2.0	7.7
*Total digestible nutrients (TDN)	28.4	71.0	72.0	75.0	78.0	76.0	55.0
*ME (MJ/kg DM)	4.2	10.7	11.0	11.3	11.8	11.5	8.3

* TDN for the (HF-Fish) and concentrate diets was determined by an *in vivo* digestion trial using sheep. For the rest of the dietary ingredients, ME was determined using *in vitro* orgainic matter digestibility (IVOMD) (Tilley and Terry, 1963), by the following equation described by MAFF (1980):

$$\text{ME (MJ/kg DM)} = (0.152\,\text{CP} + 0.342\,\text{EE} + 0.128\,\text{CF} + 0.159\,\text{NFE}) \times \frac{\text{D-value}}{100 - \text{TA}}$$

where TA = % total Ash and D-value = % IVOMD.

Rhodes grass hay. The effects of diet type and breed on feed intake and animal performance are given in table 3. There was a highly significant difference ($p < 0.001$) between the initial and final body weights of the two breeds. The local (Dhofari) goats used in this study were of the East-African dwarf type goats which are characterized by a very small body size and hardy nature. The mature body weight of the (Dhofari) goats at 3 years old ranged between 30-35 kg. The breed is originally raised in the mountains range-area in the South of Oman. Cashmere goats were introduced recently in Oman (1992), mainly to improve fiber production by some of the local farmers who are interested in weaving. It was observed that the breed had a bigger size and a higher twinning rate and it acclimatized very satisfactorily to the environmental conditions of Oman, accordingly it was intended to compare its feedlot performance and carcass characteristics with the local (Dhofari) breed. Because of their heavier body weight, Cashmere goats consumed more feed and gained more than the local goats. The difference between the two breeds was significant ($p < 0.05$) for daily feed intake and ($p < 0.01$) for daily liveweight gain. Both ME and CP intakes were higher (more than double) for the Cashmere goats compared to the local goats and they were consistent with body weight and liveweight gains of the two breeds. When feed intake was expressed as % of average body weight it was the same for both breeds (4 %). However, when feed intake was expressed on the basis of metabolic body weight ($w^{0.75}$), Cashmere goats tended to consume more feed (104 g/kg $w^{0.75}$) than local goats (82 g/kg $w^{0.75}$). In general, local animals tended to consume more roughage than Cashmere goats. % concentrate roughage ratio was 70:30 for local animals and 83:17 for Cashmere goats. Local animals were relatively more efficient in converting feed into gain, compared to Cashmere goats. However, there was no significent difference ($p > 0.05$) between breeds for feed conversion efficiency. Type of diet has no significant effect ($p > 0.05$) on feed intake, although in general animals fed on the (HF-Fish) diet consumed slightly more feed than animals fed on the conc. diet. This reflects a good palatability for the (HF-Fish) diet. Animals fed on the conc. diet tended to consume more roughage (Rhodes grass hay) than animals receiving the (HF-Fish) diet. It should be mentioned that there was relatively high fiber in the (HF-Fish) diet than in the conc. diet (table 2) and this means that the (HF-Fish) diet could be fed alone without any other roughage, or with just a very small forage

TABLE 3. EFFECTS OF TYPE OF DIET AND BREED ON FEED INTAKE AND ANIMAL PERFORMANCE (MAIN EFFECTS)*

Item	Diet		Breed		SE
	HF-Fish	Conc.	Local (Dhofari)	Exotic (Cashmere)	
Period	84	84	84	84	–
Number of animals	12	12	12	12	–
Initial body weight (BW) (kg)	23.3	23.3	13.0[a]	33.5[b]	2.4
Final BW (kg)	36.6	31.7	19.5[a]	48.8[b]	2.98
Avg. BW (kg)	30.0	27.5	16.3	41.2	–
Liveweight gain (g/day)	158.0[a]	100.0[b]	77.0[c]	182.0[d]	26.0
Feed intake (Rhodes grass hay) (g/day)	237.0	242.0	200.0	279.0	–
Feed intake (conc./HF-Fish) (g/day)	985.0	892.0	466.0	1,411.0	–
Total feed intake (g/day)	1,222.0	1,134.0	666.0[a]	1,690.0[b]	51.3
Conc./HF-Fish: Roughage ratio	81:19	79:21	70:30	83:17	–
Feed efficiency (g feed/g gain)	7.7	11.3	8.6	9.3	2.5
Feed intake as % BW (Avg.)	4.0	4.0	4.0	4.0	–
Feed intake (g)/kg $BW^{0.75}$	93.0	93.0	82.0	104.0	–
ME intake (MJ/day)	12.2	11.0	6.4	16.8	–
CP intake (g/day)	145.8	130.2	73.6	198.5	–

* Analysis of variance showed no diet × breed interactions ($p > 0.05$); therefore, main effects means were reported.
[a,b] row values, within each main effect treatment, with different superscripts differ significantly ($p < 0.05$).
[c,d] row values, within each main effect treatment, with different superscripts differ significantly ($p < 0.01$).

fraction (green forage) to improve its feeding value (N' dlovu and Buchanan Smith, 1985). However, the commercial conc. diet could not be fed alone without a roughage source as this might result in loose bowel and could affect animal performance. Animals fed on the (HF-Fish) diet significantly ($p < 0.05$) gained more weight than animals fed on the conc. diet. Feed conversion (FC) efficiency (g feed/g gain) was better for the (HF-Fish) diet (7.7) than for the conc. diet (11.3). However, there was no significant difference ($p > 0.05$) between diets for FC efficiency. Feed intake, expressed both as % body weight or on the basis of metabolic body weight ($w^{0.75}$) was very similar between diets. However intake of both energy and protein were slightly higher for animals fed on the (HF-Fish) diet.

The digestibility of the dietary fractions, N-balance and nutritive value of the two diets using sheep are shown on table 4. Both diets showed more or less similar digestion coefficients, with higher values for the (HF-Fish) diet, except EE-digestibility which was slightly higher for the conc. diet. The fish containing diet had a significantly ($p < 0.1$) higher cellulose digestibility than the conc. diet. Cell wall digestibility was also higher for the (HF-Fish) diet. In general the fiber fraction digestibility was greatly improved by inclusion of fish in the diet. CF-digestibility was increased from 39.4 to 54 (41% improvement); NDF digestibility was improved by 37%, ADF-digestibility was improved by 132% and cellulose digestibility by 106%. Although the digestibility of all the fiber fractions was improved, yet no significant difference ($p > 0.05$) between diets were reported for all the fiber fractions, except cellulose-digestibility. This could be explained by the relatively high individual variations in feed intake among sheep consuming the two diets. Slight variations in feed intake usually greatly affect CF-digestion much more than the digestion of other nutrients. The improvement in fiber digestion reported for the (HF-Fish) diet was mainly attributed to the inclusion of fish in the diet, as both diets were more or less iso-nitrogenous. This finding is in agreement with El Hag and El Khanjeri (1992) and Tan and Bryant (1991).

Effects of type of diet and animal breed on carcass quality were summarized on table 5 and 6. In general, type of diet had no significant effect ($p > 0.05$) on slaughter weight, warm carcass weight, dressing % of liveweight, empty body weight, longissimus dorsi area (cm^2) and gut fill expressed as % of liveweight. However, only slaughter weight, warm carcass weight and empty body weight were significantly different ($p < 0.05$) between the two breeds. Dressing % of liveweight,

longissimus dorsi area and gut fill were not significantly ($p > 0.05$) affected by breed. All the offals were similar and not affected by diet type, but were all significant ($p < 0.05$) affected by breed, except for the weight of kidneys. However, in general Cashmere goats had heavier weights for offals than the local goats. Results of the carcass parameters (table 5 and 6) clearly reflected that the type of diet did not affect carcass characteristics or offals and that both breeds, in this study, dressed similarly and had more or less similar degree of muscling as measured by the longissimus dorsi area. However, Cashmere goats tended to have heavier offals' weight, particularly for the weights of the skin and head. The ratios or proportions of the weight of total offals expressed as % slaughter weights were similar among diets and breeds, although in general values were relatively high for conc. diet and Cashmere goats, respectively. The % ratio of offals weight to slaughter weight for both local and Cashmere goats were similar and comparable to results reported for local and Shami goats in this Station (El Hag and El Shargi, 1992).

TABLE 4. DIGESTIBILITY OF DIETARY FRACTIONS, N-BALANCE AND NUTRITIVE VALUE OF THE CONC. AND (HF-FISH) DIETS USING SHEEP (N = 6)[1].

Item	Diet		SE[1]
	(HF-Fish)	Conc.	
Organic matter (OM)	82.0	80.0	5.0 NS
DM	79.5	76.0	5.7 NS
CP	82.0	78.5	4.7 NS
CF	55.8	39.4	15.0 NS
EE	83.7	92.6	3.0 NS
NFE	87.0	85.0	3.3 NS
NDF	61.4	44.8	13.2 NS
ADF	54.0	23.2	15.4 NS
Cellulose	72.4	35.0	11.0 ($p<0.1$)
Hemicellulose	73.3	60.0	9.8 NS
Nitrogen balance :			
N-intake (g/day)	65.5	47.0	–
Faecal N (g/day)	14.5	9.8	–
Urinary N (g/day)	5.5	5.7	–
N-retention (g/day)	45.5	31.5	13.7 NS
Nutritive value :			
% TDN	78.0	76.0	–
ME (Mj/kg DM)	11.8	11.5	–
DCP (g/kg DM)	118.0	110.0	–

[1] ANOVA for 3 sheep/diet (6 animals); NS = No significant difference ($p > 0.05$) between treatments means.
SE = Overall standard error of means.

The effects of type of diet and animal breed on costs of feeding and meat were presented in table 7. It was obvious that (HF-Fish) diet was cheaper than the conc. diet. The cost/ton (O.R) for the (HF-Fish) and conc. diets respectively were: 78 and 84. Meat cost was greatly reduced due to feeding of the (HF-Fish) diet. It was reduced, from 1.71 (O.R/kg) to 1.17, by (31%). Feeding cost for local goats was low compared to Cashmere goats, because of the small body size and low feed intake. Meat cost for local animals was cheaper than for Cashmere goats, it was about 11% cheaper.

The overall results obtained in this study, showed that it was economically feasible to feed growing local and exotic goats on pellected high-fiber (dates by-products)-fish supplemented diets without affecting diet nutritive value, animal performance and carcass quality. Local (Dhofari) goats, although small in body size, proved to be

TABLE 5. EFFECTS OF TYPE OF DIET AND BREED ON CARCASS CHARACTERISTICS (MAIN EFFECTS)*

Item	Diet		Breed		SE
	HF-Fish	Conc.	Local (Dhofari)	Exotic (Cashmere)	
Number of slaughtered animals	6.0	6.0	6.0	6.0	–
Slaughter weight (kg)	36.0	31.6	20.4[a]	47.2[b]	5.4
Warm carcass weight (kg)	18.5	16.3	10.4[a]	24.5[b]	2.75
Empty body weight (kg)	31.5	28.5	18.0[a]	42.0[b]	4.9
Dressing % of liveweight	51.4	51.6	51.0	52.0	1.7
Longissimus dorsi area (cm^2)	13.2	11.5	11.2	13.5	1.4
Gutfill as % of slaughter weight	13.0	10.0	12.2	11.0	1.4

* Analysis of variance showed no diet × breed interactions ($p > 0.05$); therefore, main effects means were reported.
[a,b] row values, within each main effect treatment, with different superscripts differ significantly ($p < 0.05$).

more efficient, and had cheaper meat cost than exotic (Cashmere) goats. These findings highlight the need for giving utmost research priority for evaluation of local resources, be it food or animal before advocating improted feeds or exotic animal breeds. This (HF-Fish) diet will be released and made accessible to the private sector for commercial production.

TABLE 6. EFFECTS OF TYPE OF DIET AND BREED ON WEIGHT OF OFFALS (kg) OF THE SLAUGHTERED ANIMALS (MAIN EFFECTS)*

Item	Diet		Breed		SE
	HF-Fish	Conc.	Local (Dhofari)	Exotic (Cashmere)	
Number of slaughtered animals	6.0	6.0	6.0	6.0	–
Head	2.6	2.2	1.30[a]	3.5[b]	0.38
Skin	3.5	3.3	1.70[a]	5.0[b]	0.59
Heart	0.17	0.14	0.11[a]	0.2[b]	0.03
Liver	0.64	0.52	0.31[a]	0.85[b]	0.08
Lungs and trachea	0.40	0.42	0.28[a]	0.55[b]	0.07
Spleen	0.08	0.07	0.05[a]	0.10[b]	0.01
Omental fat	0.97	0.92	0.6[a]	1.35[b]	0.21
Kidney fat	0.48	0.41	0.16[a]	0.73[b]	0.13
Feet	0.51	0.54	0.33[a]	0.72[b]	0.07
Genitals	0.33	0.31	0.2[a]	0.45[b]	0.03
Kidneys	0.18	0.15	0.16	0.17	0.04 NS
Alimentary tract empty	2.20	2.25	1.5[a]	3.0[b]	0.36
Weight of total offals	12.0	11.2	6.7	16.6	–
Total offals, as % of slaughter weight	33.3	35.4	32.8	35.2	–

* Analysis of variance showed no diet × breed interaction ($p > 0.05$); accordingly, main effects means were reported.
[ab] row values, within each main effect treatment mean, with different superscripts differ significantly ($p < 0.05$).

TABLE 7. COST OF FEEDING AND MEAT AS AFFECTED BY TYPE OF FEED AND BREED OF GOATS

Item	Diet		Breed	
	HF-Fish	Conc.	Local	Cashmere
Avg. amount of consumed feed (kg/day)	1.22	1.13	0.67	1.70
Cost of consumed feed/day* (Baisa)	94.5	92.6	52.6	134.5
Avg. daily gain (kg)	0.158	0.10	0.077	0.182
Cost/kg gain (Baisa)	597	886	688	794
Cost/kg meat** (Baisa)	1,172	1,705	1,355	1,522

* Cost of consumed feed/day was calculated by considering cost of one kg of (HF-Fish) diet to be = 78 Baisa; one kg of Rhodes grass hay to be = 75 Baisa and cost of one kg (conc.) to be = 84 Baisa.
** Cost of meat was calculated by using the dressing % of the liveweight of the different breeds of goats fed on the two diets (table 5).

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