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# Utilization of corrugated cardboard in fattening rations of Awassi lambs

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## Abstract

A feeding trial was conducted with fattening Awassi lambs using corrugated carton to study the nutritional effect of this by-product and to search for low cost rations. Thirty male lambs were assigned to three dietary treatments. The control diet was composed of 40% barley, 16% soybean meal, 12% wheat bran, 1% limestone, 1% salt, 1% lambs' premix and 29% wheat straw. To each of the experimental rations, carton was incorporated instead of wheat straw at levels of 10 and 20%, respectively. Cardboard was treated with urea prior to use. The lamb feeding trial extended for a period of 40 days. Average initial live weights were 29.6, 29.9 and 29.5 kg for each of the three groups, respectively. Mean daily gains were 210, 200 and 205 g per day for each of the three groups, respectively. Average feed conversion rates were 6.3, 6.7 and 6.8 kg feed per kg gain and the feed costs per kg gain were US\$ 0.94, 0.87 and 0.74 for each of the three treatments, respectively. The results of the experiment indicated that the low levels of carton in lambs fattening rations had no disadvantages on performance compared to the control ration used. The experiment showed that, under current feed prices in the Palestinian Authority, replacing up to 20% of wheat straw with carton proves to be beneficial and economically feasible. © 2001 Elsevier Science B.V. All rights reserved.

*Keywords:* Corrugated carton; Daily gain; Feed conversion; Awassi lambs

## 1. Introduction

The animal production sector plays an important role in agriculture in the Palestinian Authority. This sector contributes about 50% of the total income from agriculture (MOA, 1998). The major type of livestock raised in the Palestinian Authority is sheep and goats (Abo Omar, 1998). Recent statistics showed that the number of sheep in the Palestinian Authority is 700,000 heads, while the number of goats is about 400,000 heads (MOA, 1998; Abo Omar, 1998).

There are several obstacles facing the livestock sector, among these is the feed problem. It is well

documented that local feed costs make up to 75% of the total costs of any livestock operation in the Palestinian Authority (Abo Omar, 1998). The high cost of feed causes profitability of livestock business to be marginal.

To help solving this problem, attempts were made to use certain agricultural and agro-industrial by-products as feed ingredients to livestock. Olive cake (a by-product of olive fruits processing) was fed to lambs at rate of 20% without any harmful effect (Abo Omar and Gavoret, 1995; Harb, 1982), and olive pulps were fed to 1-day-old broilers at the rate of 5% (Abo Omar, 2000). However, other by-products, such as poultry manure (Al Said, 1996), corrugated cardboard (KISR, 1982), recycled newsprint (Wolf et al., 1994)

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were used in lambs, sheep and lambs rations, respectively.

In 1998, about 40–50 thousand tons of corrugated cardboard were produced by the paper packing industry in the Palestinian Authority (officials at the ministry of supply, Ramalla city, the Palestinian Authority, personal communications). The volume of this type of waste is accumulated faster than it can be utilized. With the increasing numbers of livestock, especially ruminants, corrugated cardboard can be a potential source of feed ingredients for ruminants (KISR, 1982). High profitability could be achieved by substituting the locally expensive hays with cardboard. Attempts to use such material as a feed source for ruminants have not been successful (Belyea et al., 1987). Belyea et al. (1987) fed dairy heifers cardboard at levels of 25 and 60%. Incorporation of cardboard had negative effects on heifers' general performance and caused a depression in dry matter and nutrients digestibility. It was suggested that chemical and physical treatments could increase the utilization of the corrugated cardboard. The objective of this paper was to investigate the performance of Awassi lambs fed treated corrugated cardboard.

## 2. Materials and methods

A total of 30 male Awassi lambs of about 3 months of age were purchased from the local livestock market. The lambs were of similar body weight and size. Lambs were treated against internal and external parasites soon upon arrival to the experimental farm. At the same time, all lambs were treated against enterotoxemia.

After a short period of adaptation, animals were divided into three groups of 10 animals each, for two experimental groups and a control. The experimental groups were fed the corrugated carton at low levels (Table 2). All diets were isonitrogenous. The cardboard was incorporated to replace wheat straw in lambs' diets at rates of 10 and 20%, for the experimental groups 2 and 3, respectively. Group 1 was the control group.

Prior to ration formulation, the cardboard was obtained from wastes of a major paper factory, transported to the experimental farm where it was chopped by a hay chopper to a size of about 2 cm. The chopped

carton was incorporated in the experiment diets as shown in Table 2. Cardboard was treated with urea according to Abo Omar et al. (1997). Each 1 kg of cardboard was treated with 400 ml of 10% urea solution (*w/v*) (42.9 g urea/kg DM). A ground sample of carton was taken and stored for later analysis. However, grab samples of the three fed rations were taken for later analysis.

Animals were assigned to the three groups with similar mean weight and were fed as a group, twice daily, at 7.00 and 18.00 h. Lambs were weighed on a weekly basis during the experimental period which lasted 6 weeks.

Feed samples were analyzed for dry matter, crude protein, crude fiber, crude fat, lignin, gross energy, calcium, and phosphorus, potassium, and magnesium according to AOAC (1990).

The experimental design used was the complete randomized design and all data were statistically analyzed by ANOVA using the SAS package (SAS, 1987).

## 3. Results and discussion

The chemical composition of cardboard is presented in Table 1. The results show that the crude protein content was very low, about 1.3% of dry material. The crude fiber concentration was about 69.9% of dry material. Cardboard was found to contain a fairly high amount of calcium, but the level of phosphorus was extremely low. These findings are consistent with reports by Al-nasser et al. (1981); Coombe and Briggs (1974). The results suggest that a nitrogen source should be added to correct crude protein deficiency in cardboard containing rations fed to ruminants.

Table 1  
The chemical composition of corrugated carton used in the experiment (g/kg DM)

Parameter	g/kg
CP	13.0
Crude fiber	699.0
Ether extract	7.0
Ash	4.0
Nitrogen free extract	260.0
Ca	1.0
P	0.1

Table 2  
The composition of diets used in the experiment (%)

Ingredient (as fed)	1	2	3
Cardboard	–	10	20
Barley	40	40	40
Soybean meal	16	16	16
Wheat bran	12	12	12
Wheat straw	29	19	9
Limestone	1	1	1
Salt	1	1	1
Lambs' premix <sup>a</sup>	1	1	1
Total	100	100	100
Chemical composition (g/kg DM)			
Ash	51.3	44.0	37.5
CP	17.4	17.3	17.1
EE	25.0	24.0	24.0
Lignin	45.0	42.0	44.0
Cellulose	180.5	189.6	270.0
P	1.8	2.0	1.07
Ca	6.5	5.8	5.9
K	7.5	6.65	5.05
Mg	1.93	1.88	1.93
Energy (kcal/g DM)	4.10	4.2	4.25

<sup>a</sup> Lambs premix: 65% shelled corn, 30% SBM, 5% Vitamin A and antibiotics.

The composition of the three rations is shown in Table 2. The rations compounded from cardboard and other ingredients did not differ in crude protein (CP) and ether extract (EE) contents. The cellulose level was higher ( $P < 0.05$ ) in the rations containing the high level of cardboard. However, cellulose levels ranged from 180.5 to 270.0 g/kg DM.

Live weight gain and feed conversion ratios are shown in Table 3. Addition of cardboard to lambs rations at both levels had similar effects compared to the control ration. Average daily gain was 210, 200 and 205 g per day for control, 10 and 20% cardboard groups, respectively. The differences in gains of the three groups were not significant. This means that addition up to 20% of cardboard in fattening lamb diets did not affect the lambs' growth performance. Hammad (2001), Abo Omar and Gavoret (1995), Harb (1982), Al-nasser et al. (1981) reported similar results when Awassi lambs' diets contained high levels of fiber.

The duration of the experiment was only 40 days; a longer duration for feeding these diets might have produced different responses.

The feed conversion ratios (kg feed/kg gain) were 6.3, 6.7 and 6.8 for the control, 10 and 20% cardboard containing rations, respectively.

Economically, the calculated cost per kg gain were US\$ 0.94, 0.87 and 0.74 for the three diets used in the experiment, respectively (Table 3). The highest profit was reached when cardboard was used at the higher levels compared to lower levels.

In conclusion, it is recommended by the study that it is possible to add cardboard into fattening diets for lambs at 10 and 20% in replacement of wheat straw.

These levels had no harmful effect on the average daily gain or on the feed conversion efficiency.

According to current local prices, it is estimated that replacement of 20% of the total amount of wheat straw

Table 3  
The performance of Awassi lambs fed corrugated carton (mean + S.E.)<sup>a</sup>

Item	Control	10% cardboard	20% cardboard
No. of lambs	10	10	10
Days of experimentation	40	40	40
Initial mean weight (kg)	29.6 (2.1)	29.1 (2.5)	29.5 (2.4)
Final mean weight (kg)	38.0 (3.0)	37.9 (2.8)	37.7 (2.6)
Mean daily gain (g)	210 (35)	200 (39)	205 (41)
Daily feed intake (kg)	1.32	1.35	1.4
Feed conversion efficiency (kg feed/kg gain)	6.3 (1.8)	6.7 (1.7)	6.8 (1.9)
Cost of total gain <sup>b</sup>	7.9 (1.0) a	7.0 (1.0) b	6.1 (1.0) c
Cost of diets <sup>b</sup>	0.15	0.13	0.11
Cost of 1 kg gain <sup>b</sup>	0.94 (0.9) a	0.87 (0.8) a	0.74 (1.0) b

<sup>a</sup> Means in a row without a common letter differ ( $P < 0.05$ ).

<sup>b</sup> All costs are in US dollars.

used in fattening rations with cardboard could save US\$ 0.8 million each year in the Palestinian Authority.

#### 4. Conclusion

The present results demonstrated the potentiality of using the urea treated cardboard in lambs' fattening rations. Urea treated cardboard can replace 20% of wheat straw. This is of great advantage to farmers in rural areas of the Palestinian Authority.

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