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Feeding value of under-utilized food byproducts and forages as alternatives to conventional feeds for Syrian Awassi sheep

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Abstract

The search for alternative feed resources for livestock not competing with human nutrition is getting increasingly important during the current food crisis. In semi-urban areas of dry regions of the Middle-East, there are quite a number of under-utilized feeds which include both agro-industrial by-products and forages. However, these alternatives probably differ largely in nutritional value. So far only few studies investigated and compared such under-utilized feeds. Two comparative experiments using 2x5 diets, characterized by one feed each, were conducted in the present study. Per diet, six castrated male Awassi (fat-tailed) sheep were employed. Diets in Expt. 1 had a barley straw:concentrate ratio of 0.5:0.5 with 2/3 of the concentrates being either barley/wheat bran (control), tomato pomace, olive cake, sugar beet pulp or broken lentils. In Expt. 2, diets with a forage:concentrate ratio of 0.73:0.27 contained either barley straw (control), olive leaves, lentil straw, *Atriplex halimus* foliage or vetch hay as the only forages. Feed amount offered was 1.1 kg dry matter/day. In Expt. 1, palatability of olive cake was low, and comparative calculations from dietary organic matter (OM) digestibility (0.48 of intake) suggest that metabolizable energy is only 1.9 MJ/kg dry matter. Diets based on sugar beet pulp (0.68) and broken lentil (0.69) were similar to control (0.66), while the tomato pomace diet ranged slightly lower in digestibility (0.59). The *Atriplex*-based diet had a relatively high digestibility of fiber (NDF, 0.58) and OM (0.71), but content of digestible OM was limited by its high salt content. Additionally, *Atriplex* leaves at that level were either not completely consumed or caused diarrhea and 2.5-fold water intakes. The other forages were quite similar in digestibility, except the well-digestible vetch hay, and no significant effects on body N-balance were noted. The study showed some promising alternatives to traditional feeds, while others (e.g. olive cake) might be used at low levels only. *Atriplex* is a special case, where also the extra water expenditure might restrict its use.

Keywords: Sheep, Digestibility, *Atriplex*, Sugar beet pulp, Lentil, Olive leaves, Tomato pomace, Vetch hay.

Introduction

After the grain crisis and the droughts occurring in many countries, global efforts have been made in order to improve the production systems and resource use efficiency in dry areas. This situation is even more serious in areas depending mainly on livestock-related agriculture like Syria. Fat-tailed sheep (Awassi) constitute an important source of income to the country which holds the largest Awassi sheep population in the Middle East. However, the climatic conditions and water scarcity prevalent for many years were a cause to prices increase for many traditional feeds, to competition with human nutrition and to overexploiting the limited grazing areas. Research on animal nutrition is now especially focusing on finding solutions to overcome feed scarcity. Finding alternatives to conventional feeds by introducing new drought-resistant plant species and using agro-industrial by-products are among the suggested solutions. In semi-urban areas of dry regions of the Middle-East, there are quite a number of under-utilized feeds which include both agro-industrial by-products and forages. However, these alternatives probably differ largely in nutritional value. So far only individual studies investigated such under-utilized feeds. The difference among the experimental designs and conditions makes the comparison of the different options quite difficult. Therefore, the aim of the present study was to simultaneously investigate the feeding value either of various alternative forages or of concentrate ingredients available locally under the controlled conditions of digestibility experiments.

Material and methods

In two experiments, concentrate ingredients and forages were tested for their effects on feed intake, nutrient digestibility and N balance. Per diet, six castrated male Awassi (fat-tailed) sheep weighing on average 42 ± 4 and 40 ± 5 kg (Expt. 1 and 2, respectively) were allocated for 15 days in 1.6×1.2 m² cages for the adaptation period, followed by 10 days of complete collection of faeces and urine and measurement of feed refusals and water consumption in metabolism crates. In the first experiment, concentrate ingredients constituted 50% of the diet dry matter (DM) where 33% were represented by the tested feeds (tomato pomace, olive cake, sugar beet pulp and broken lentil instead of a control constituted by barley/wheat bran). In the second experiment, diets were tested where 73% of dry matter were represented by the experimental forages which replaced barley straw (control): olive leaves, lentil straw, *Atriplex halimus* (saltbush) foliage or vetch hay. Diets were isonitrogenous and supplemented with a vitaminized mineral-salt mixture. Animals were offered 1.1 kg dry matter/d and free access to water. Feeds, refusals and feces were analyzed for their proximate contents by standard methods and urine-N was additionally determined. The content of the digestible organic matter in dietary dry matter was calculated from organic matter content and organic matter digestibility. Data were subjected to analysis of variance with diet as effect. Multiple comparisons among means were made by Tukey's procedure.

Results and Discussion

In Experiment 1, the concentrate containing olive cake could be clearly distinguished in dry matter digestibility from the concentrates characterized by other experimental ingredients in the first experiment (Figure 1). Indeed, the low metabolizable energy of the olive cake (only 1.9 MJ/kg dry matter as estimated from *in vitro* digestibility measurements in relation to the control diet) affected its digestibility. Its low palatability was reflected by its certain adverse effect on intake compared to the control and the other groups (data not shown), which was particularly pronounced in the adaptation period. In the other groups, dry matter intake was not significantly different from the control. Water consumption, daily weight change and body N retention (N

balance) also were not significantly different among groups. The apparent digestibilities (DM, CP) as well as the concentration of digestible organic matter in dry matter of the other alternatives differed only slightly, with the tomato pomace diet being lower and sugar beet pulp as well as broken lentil diets being similar to the barley-based control diet.

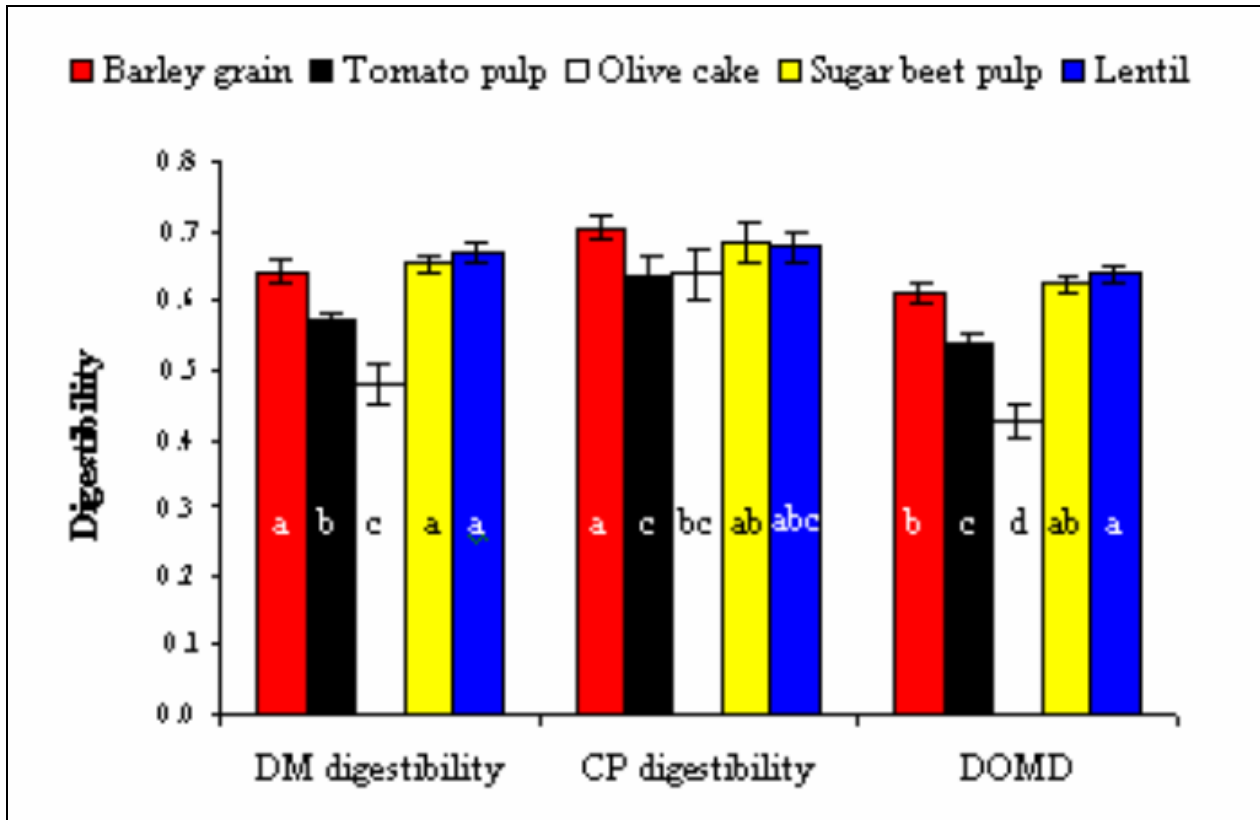


Figure 1. Apparent dry matter (DM) and crude protein (CP) digestibility in sheep fed different concentrate ingredients and calculated proportion of digestible organic matter in dietary dry matter (DOMD) in Experiment 1. Means within trait carrying different letters are significantly different at $P < 0.05$.

In Experiment 2, dry matter intake was not significantly different among the forage types, with the exception of the Atriplex group where the foliage was either not completely eaten or caused diarrhea when consumed at high amounts. The water consumption feeding the Atriplex diet was about three times that of the other groups. Apparent digestibilities of dry matter and crude protein of the Atriplex diet were significantly higher than that of the barley straw diet (control) and of the other diets containing test forages (Figure 2). The content of digestible organic matter in diet dry matter was, however, similar as that of the other diets since Atriplex contained less organic matter due to its high salt content. Lentil straw and olive leaves were similar to control in dry matter digestibility and content of digestible organic matter in dry matter, whereas the CP digestibilities of the olive leaf and the vetch hay diets were lower than that of control. The vetch hay was well digestible as can be seen from the second highest dry matter digestibility and the highest content of digestible organic matter in dry matter.

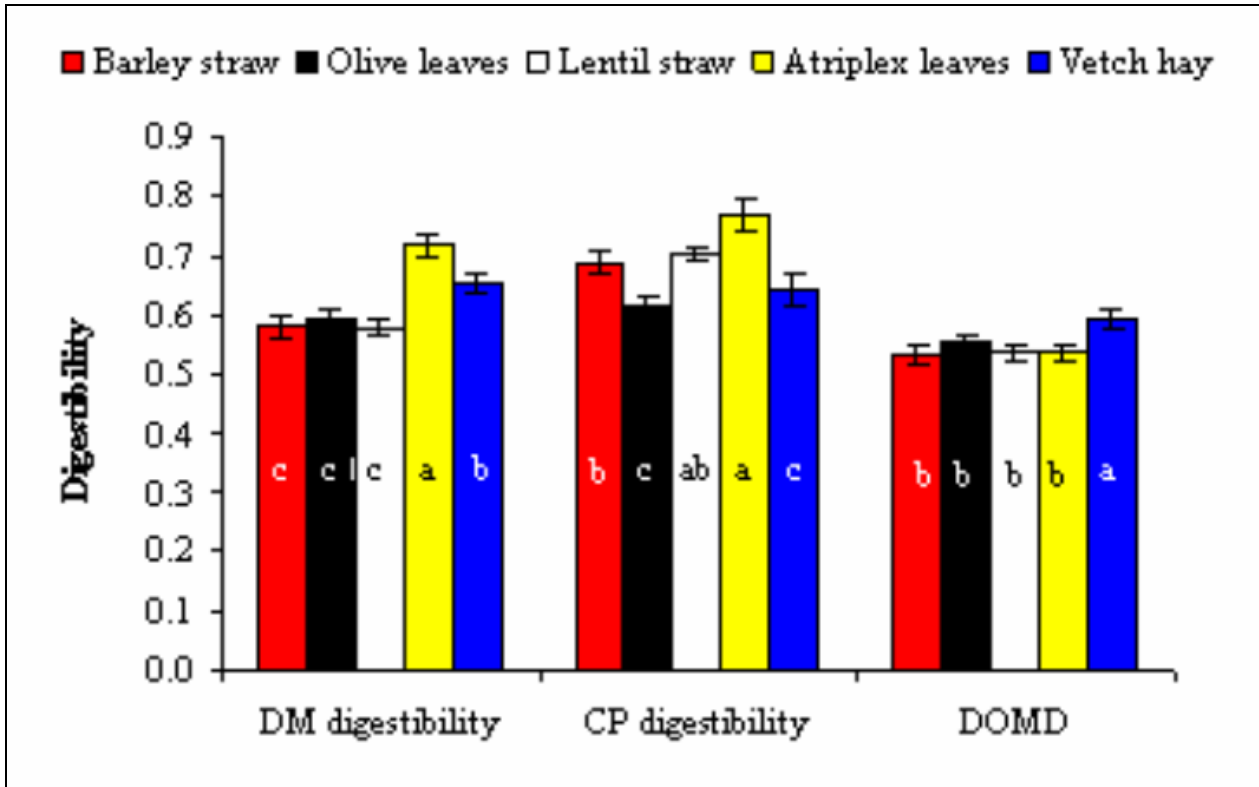


Figure 2. Apparent dry matter (DM) and crude protein (CP) digestibility in sheep fed different forage types and calculated proportion of digestible organic matter in dietary dry matter (DOMD) in Experiment 2. Means within trait carrying different letters are significantly different at $P < 0.05$.

Conclusion

From these results, some forages (e.g. olive leaves) and concentrate ingredients (tomato pomace) evolved to be promising alternatives to conventional feeds, while others (e.g. olive cake) might be useful at low levels only. Atriplex is a special case, where also the extra water expenditure might restrict its use. The ongoing research about the effect of these alternatives on Awassi ewe milk yield and quality will help to confirm these results and assist to identify further properties of the experimental feeds in terms of compositional, physical and sensory milk quality.