

Nutritional Performance of Dry She-Camels Fed *Atriplex halimus* (Saltbush) For Prolonged-Period

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ABSTRACT

Eighteen adult dry she-camels with an average body weight of 374.33±15.35 kg were distributed by weight into three equal groups (six animals each). The first group was fed berseem hay (BH) ad libitum (the control group) for 360 days. The second and third groups were fed ad libitum fresh leaves and succulent stems of *Atriplex halimus* (saltbush) for 180 days (short-period) and 360 days (long-period), respectively. Each camel in the experimental groups was supplemented with a concentrate diet consisting of 60 % ground yellow corn plus 40% ground barley grains to cover 100% of the maintenance energy requirements. The effects of the prolonged period of feeding atriplex halimus on feed utilization, nitrogen balance and dry she-camel performance were studied. The short-period camel group recorded the highest ($P<0.05$) dry matter intake (DMI) compared to long-period and control, respectively (75.64 vs. 70.96 and 67.04 g/day/Kgw0.75). Whereas, the digestibility of DM, OM and NFE was not affected ($P > 0.05$) by changing either the type of roughage or period feeding of atriplex. On the other hand, CP, CF and EE digestibility were decreased ($P<0.05$) by feeding atriplex either for short or long periods; nevertheless, it was noticeable that CP, CF and EE digestibility when atriplex was fed for long-term were higher ($P<0.05$) than those fed atriplex for short-period. Camel group fed the atriplex for the long period tended to retain more nitrogen ($P<0.05$) than the short-period and BH groups, respectively. Present results indicated that camels can be successfully adapted to prolong feeding of saltbushes.

Key words: She camel, atriplex, digestibility, nutritive value and nitrogen retention.

INTRODUCTION

Dromedaries are adapted in dry and semi-dry areas, mainly in the deserts. In scarce seasonal, changeable feed and water sources, Dromedary Camels can preserve themselves by consuming halophytes (Wilson, 1984). The feed and water needs comparatively less than other animals, and can obtain more energy from their consuming feed (Farid et al., 1979; Yagil, 1981). The little water necessities let camels feed from more regions far away from H₂O resources for feed searching (Schmidt-Nielsen, 1964).

The biomass production and quality of the natural rangelands in such areas vary considerably from season to season and from area to area depending on several factors, mainly environmental factors

(ElShaer, 1995, 2004 and 2010). Consuming halophytic plants and other salt-tolerant plants in the ration of ruminants is a possible key to reduce the difficulties of feed and water availability in arid and semi-arid regions (Al-Shorepy et al., 2010; Moreno et al., 2015; Mahmoud et al., 2016).

The objective of the current work was to assess the extended period outcomes of consuming atriplex on camel's feed intake, apparent digestibility, nutritive value, water intake, and nitrogen utilization.

MATERIALS AND METHODS

Eighteen adult she-camels (*Camelus dromedarius*) with a mean body weight of 374.33 ± 15.35 kg were distributed according to weight into three equal groups (six she-camels each). The first group was fed berseem hay (BH) *ad libitum* for 360 days (control group). The 2nd and 3rd groups were fed *ad libitum* fresh leaves and succulent stems of *Atriplex halimus* for 180 days (short-period) and for 360 days (long-period), respectively. Each camel in the experimental groups was supplemented with a concentrate diet consisting of 60% ground yellow corn plus 40% ground barley grains to cover 100% of the maintenance energy needs according to the recommendations of Wardeh and Farid (1990). Fresh water was freely available once a day. For digestibility trials, camels were placed in individual metabolic cages that were designed for daily collection of feces and urine for each camel. Camels were allowed two weeks in metabolic cages for adaptation before starting the collection period, which lasted seven days. During the collection time, feed refusals (if any), feces, and urine were quantitatively collected once every day before feeding. Composite dried samples of feces were ground for laboratory analysis. Urine was daily collected in bottles including fifty ml of 50% H_2SO_4 and specimens were taken daily and frozen until later chemical analysis. The chemical compositions of the experimental feeding, feed orts, feces, and urinary nitrogen were defined according to the steps of AOAC (1990).

The numbers acquired from the lab results were evaluated by the statistical analysis system using GLM procedures according to SAS (1988). Mean differences were compared by the Duncan Multiple Range Test (Duncan 1955).

RESULTS AND DISCUSSION

Chemical composition of the experimental diets

Data in Table 1 shows that fresh atriplex halimus had higher crude protein (CP), ash content, and lower dry matter (DM), organic matter (OM), and nitrogen-free extract (NFE) content compared to berseem hay (BH).

Table (1): Proximate composition (%) of feed ingredients (on DM basis)

| Feedstuffs | DM (%) | DM composition (%) | | | | | |
|------------------|--------|--------------------|-------|-------|------|-------|-------|
| | | OM | CP | CF | EE | NFE | Ash |
| Barley grains | 86.33 | 96.50 | 10.12 | 6.04 | 2.91 | 77.43 | 3.50 |
| Yellow corn | 87.10 | 98.66 | 8.23 | 1.82 | 5.30 | 83.31 | 1.34 |
| Berseem hay | 87.06 | 87.50 | 12.28 | 30.93 | 2.77 | 41.52 | 12.50 |
| Atriplex halimus | 25.69 | 79.25 | 17.50 | 23.88 | 2.92 | 34.95 | 20.75 |

Voluntary feed intake and body weight change

Dry matter intake ($g/Kgw^{0.75}$) was considerably affected ($P < 0.05$) by either changing the period of feeding or the type of roughage (Table 2). In this respect, Farid *et al.* (2010) reported that

roughage DMI intake differed ($P < 0.01$) with changing the type of roughage; nevertheless, it was highest in the Atriplex camels group, smallest in the straw group and intermediate in the hay group. The daily DMI by the camel group of short-period (6 months) feeding atriplex was greater ($P < 0.05$) than the DMI values for the other two camel groups. Although feeding atriplex for long-period decreased daily DMI ($\text{g/d/Kgw}^{0.75}$), it was still insignificantly higher than the DMI value for the control camel group. Shawket *et al.* (2010) reported that this might be due to the progressive camel reaction to Atriplex consumption, which is due to two main influences: First, camels need more salt, which is relatively more than other herbivores. Chamberlain (1989) stated that camels need 6 to 8 times the quantity of salt required by other animals. Consequently, camels deprived of a steady approach to salty feed need about one hundred and forty g of salt per day. So, conventional grazing management by most breeders involves regular supplementation of salt, usually by moving the dromedaries to saline pastures and wells or salty earth, at least twice a year. It is supposed that if camels do not have salty grazing, they will lose condition, abort, give less milk, and be more susceptible to diseases like skin necrosis and arthritis (Peck, 1939; Bornstein, 1995). 2nd, in contrast to cattle, the saliva of camels has a varying content of high molecular weight mucin glycoprotein (MGP) that presents a defense to the mucosa of the digestive tract from mechanical damages and treats with the plant tannins, avoiding their negative effects on protein metabolism in the rumen (Schmidt-Witty *et al.* 1994). Furthermore, atriplex is a lush green plant. It is more palatable to camels in contrast to the dry, long clover hay (Shawket *et al.*, 2005). Additionally, Mahmoud *et al.* (2016) explain that the higher DM intake by camels from halophytes can be due to the great amounts of ash and lower OM content. This result agreed with the results of Basmaeil *et al.* (2004) and Al-Shorepy *et al.* (2010), who indicated that camels were able to increase their DMI from the salicornia diets matched with Rhodes grass to compensate for the lower OM content of salicornia.

Table (2): Body weight changes, voluntary feed intake, and water consumption of camels affected by either the type of roughage or period of feeding.

| Items | Experimental camel groups | | | Sign. |
|---------------------------------|--------------------------------|--------------------------------|--------------------------------|---------|
| | Control | Short-period | Long-period | |
| Number of animals | 6 | 6 | 6 | |
| Experimental duration (day) | 360 | 180 | 360 | |
| Initial body weight (kg) | 375.00 ± 16.07 | 372.00 ± 12.34 | 376.00 ± 17.65 | NS |
| Final body weight (kg) | 573.66 ^b ± 12.99 | 453.45 ^c ± 7.96 | 595.89 ^a ± 18.37 | * |
| Body weight changes (g/ day) | 550.00 ^b ± 20.62 | 450.00 ^c ± 41.86 | 610.81 ^a ± 70.02 | * |
| Total dry matter intake (g/day) | 6813.94 | 6926.04 | 7316.37 | NS * |

| | | | | |
|--|--------------------|---------------------|---------------------|----|
| g/day/kg w | 14.37 ^b | 16.78 ^a | 15.06 ^{ab} | |
| g/day/kgw ^{0.75} | 67.04 ^b | 75.64 ^a | 70.69 ^{ab} | * |
| Total water intake ml/kgw ^{0.82} | 31.35 ^c | 140.57 ^a | 113.76 ^b | ** |

^{a, b, c} means followed by different superscripts within each row are significantly different (* $P < 0.05$), (** $P < 0.01$), and ns = Non-significant

Also, daily weight change (g/day) was influenced ($P < 0.05$) by either altering the type of roughage or the period of feeding atriplex. Altering the type of basal diet by substituting atriplex instead of BH decreased ($P < 0.05$) the daily weight change (g/day) of camels fed atriplex in the short period. While the daily body weight change of camels fed atriplex for long-period increased ($P < 0.05$) by about 11% and 35.7% more than the other two camel groups fed the control diet and atriplex for short-period, respectively. This indicates that camels can be positively adapted to long-period halophytic pasture plant feeding.

Total water intake (ml/Kgw^{0.82}) was significantly affected ($P < 0.01$) by the type of roughage and period of feeding atriplex. The higher total drinking water intake by animal groups fed atriplex either for short-period or long-period might be attributed to the greater seasonal contents of Na, which ranged between 5.59 and 6.66% in the DM of atriplex foliage for the spring and fall seasons, respectively (Abu-Zanat *et al.*, 2003). This elevated level of salt in Atriplex browsing may oblige animals to raise their daily water intake (Abu-Zanat and Tabbaa, 2006). Significantly, data of water intake indicated that prolonged feeding of atriplex to camels decreased their water intake compared with those fed atriplex for the short term. This fact settled the early assumption of Farid *et al.* (1985) and Abou El-Nasr *et al.* (1988) that camels were apparently better adapted for handling salt loads, being more economical in their needs of water intake.

Nutrient digestibility, nutritive value, and nitrogen balance

Dry matter (DM), organic matter (OM) and nitrogen-free extract (NFE) digestibility were not significantly ($P > 0.05$) affected by changing either the type of roughage or the period of feeding atriplex (Table 3). On the other hand; crude protein (CP), crude fiber (CF), and ether extract (EE) digestibility were generally decreased ($P < 0.05$) by feeding atriplex either for short-period or long-period, nevertheless, it was noticeable that CP, CF and EE digestibility when atriplex was fed for long-term were higher ($P < 0.05$) than that of feeding atriplex for short-period. Decreasing CP, CF, and EE digestibility by feeding atriplex instead of BH may be due to the higher salt content of atriplex which is the major negative component in Atriplex species (Wilson, 1992), which leads to increased animal water intake and shortening rumen turnover times, with consequential influences on rumen physiology and metabolism (Warner and Casson, 1992; Konig, 1993). The improvement of CP, CF, and EE digestibility, when atriplex was fed over the long term, may be because rumen microorganisms will be adapted to overcome the impaired effect of atriplex secondary metabolites on rumen metabolism.

Table (3): Nutrients digestibility, nutritive value, and nitrogen balance of camels affected by either the type of roughage or period of feeding.

| Item | Experimental camel groups | | | Sig. |
|-----------------------------|---------------------------|---------------------|---------------------|------|
| | Control | Short-period | Long-period | |
| Nutrients digestibility % | | | | |
| DM | 73.20 | 69.16 | 70.87 | NS |
| OM | 72.55 | 69.20 | 72.44 | NS |
| CP | 70.29 ^a | 64.18 ^b | 67.69 ^{ab} | * |
| CF | 65.87 ^a | 57.66 ^b | 60.77 ^{ab} | * |
| EE | 68.18 ^a | 61.23 ^b | 64.68 ^{ab} | * |
| NFE | 73.65 | 70.30 | 71.26 | NS |
| Nutritive value % | | | | |
| TDN | 70.00 ^a | 64.61 ^b | 69.68 ^a | * |
| DCP | 7.20 ^b | 9.70 ^a | 8.00 ^{ab} | * |
| Nitrogen balance | | | | |
| mg N/day/kg ^{0.75} | 302.36 ^b | 290.85 ^b | 384.77 ^a | * |

^a and ^b means followed by different superscripts within each row are significantly different (*P < 0.05) and NS = non-significant.

The nutritive value (%) expressed as total digestible nutrients (TDN) was decreased (P<0.05) by feeding atriplex for a short period than camels fed atriplex for a long period, which was comparable with the TDN value of the control camel group. This may be due to the low CP, CF, and EE digestibility during feeding atriplex for the short. But it is noteworthy to mention that digestible crude protein (DCP) value increased (P<0.05) with feeding atriplex either for short-period or long-period instead of BH, which may be attributed to its higher CP (%) content and its rapid fermentation characteristic than BH (17.50 vs. 12.28 CP%, respectively).

The camel group fed the atriplex for long-period tended to retain higher (P<0.05) nitrogen than the other two camel groups fed the atriplex for short-period and BH, respectively. Apparent N utilization, (%) values were greater (P<0.05) for camel groups fed BH and atriplex for long-period than those of short-period feeding the atriplex. Results obtained indicated that the extended feeding of Atriplex as a saltbush did not affect the camel's efficiency of nitrogen utilization.

CONCLUSION

Current outputs showed that camels can tolerate the negative impact of prolonged grazing saltbush supplement with a suitable source of energy when traditional grazing resources are particularly scarce and well-performing.

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الملخص العربي

طول فترة تغذية إناث الجمال الجافة على القطف الملحي على المادة الجافة المأكولة ، معاملات تأثير

الهضم والإستفاده من نيتروجين العليقة

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أستخدم في هذه الدراسة عدد 18 أنثى جمل بالغة بمتوسط وزن 374.33 ± 15.35 كجم تم تقسيمها إلى ثلاث مجاميع متماثلة (6) حيوانات في كل مجموعة) وتم تغذيتها كما يلي:
المجموعة الأولى (الكنترول) غذيت على دريس البرسيم للشبع لمدة 360 يوم
المجموعتين الثانية والثالثة غذيت على القطف الملحي للشبع لمدة 180 و 360 يوما على التوالي.
تم إضافة الشعير والذرة للمجاميع الثلاثة كمصدر للطاقة بنسبة 40:60 بما يوازي 100% من الإحتياجات الحافظة من الطاقة. وذلك بهدف دراسة تأثير التغذية طويلة الأجل على القطف الملحي على المادة الجافة المأكولة ومعاملات الهضم والإستفاده من نيتروجين الغذاء.

أظهرت النتائج أن التغذية على القطف لفترة 360 يوما قد أدت إلى إنخفاض معنوي ($P < 0.05$) في كمية المادة الجافة المأكولة ($gm/Kgw^{0.75}$) مقارنة بمجموعة الجمال المغذاة على القطف لمدة 180 يوما ولكنها مساوية معنويا لكمية المادة الجافة المأكولة لمجموعة الكنترول. في حين أن التعبير في وزن الجسم (gm/day) قد زاد معنويا ($P < 0.05$) للمجموعة المغذاه على القطف لفترة 360 مقارنة بالمجموعة المغذاه على القطف لمدة 180 يوما ومجموعة الكنترول. معاملات هضم المادتين العضوية والجافة والكربوهيدرات الذائبة لم تتأثر معنويا بطول فترة التغذية على القطف أو بالمقارنة بمجموعة الكنترول. ولكن لوحظ أن معاملات هضم البروتين والألياف والدهن قد إنخفضت معنويا ($P < 0.05$) نتيجة التغذية على القطف عموما سواء لفترة قصيرة أو طويلة مقارنة بمجموعة الكنترول. في حين لوحظ أن زيادة طول فترة التغذية على القطف قد أدت إلى تحسن معنوي ($P < 0.05$) في معاملات هضم البروتين والألياف والدهن مقارنة بالفترة القصيرة. تحسنت قيمة مجموع المركبات الغذائية المهضومة ($TDN\%$) معنويا ($P < 0.05$) بطول فترة التغذية على القطف (360 يوما) وإن كانت متساوية معنويا مع مجموعة الكنترول، في حين زاد البروتين الخام المهضوم ($DCP\%$) معنويا ($P < 0.05$) نتيجة التغذية على القطف بصفة عامه مقارنة بمجموعة الكنترول. إنخفضت كمية المياه المستهلكة يوميا للوحدة من وزن الجسم ($ml/day/Kgw^{0.82}$) معنويا ($P < 0.01$) بحوالي 19% مع زيادة طول فترة التغذية على القطف (360 يوم) مقارنة بالمجموعة المغذاه على القطف لفترة قصيرة (180 يوم) وعموما فإن كمية المياه المستهلكة يوميا للمجاميع المغذاه على القطف كانت أعلى ($P < 0.01$) من مجموعة الكنترول. أدت التغذية على القطف لفترة طويلة إلى زيادة كمية النيتروجين المحتجز معنويا ($P < 0.05$) مقارنة بمجموعة الجمال المغذاه على القطف لفترة قصيرة وكذلك مجموعة الكنترول وكانت النسبة المئوية للنيتروجين المحتجز منسوبا للنيتروجين المأكول ($NB/NI\%$) أعلى معنويا ($P < 0.05$) لمجموعة الجمال المغذاه لفترة طويلة على القطف مقارنة بالمجموعة المغذاه لفترة قصيرة ومتماثلة معنويا مع مثيلاتها لمجموعة الكنترول. ولقد أظهرت النتائج المتحصل عليها القدرة الفائقة للجمال على التأقلم عند تغذيتها ولفترات طويلة الأجل على القطف الملحي وبدون أية آثار سلبية بل كانت نتائجها أكثر إيجابية من التغذية لفترات قصيرة الأجل على القطف الملحي.

الكلمات الدالة: إناث الجمال، القطف الملحي، معاملات الهضم، وزن الجسم