Effect of breed, age and sex on selenium content of dromedary camel *Longissimus dorsi* muscle

Naima Sahraoui*[1], Saliha Boudjenah[3], Olivier Dotreppe[2], Mohamed Brahim Errahmani[4], Baaissa Babelhadj[3], Djamel Guetarni[1], Jean-Luc Hornick[2]

1*Department of Veterinary Sciences, Faculty of Agro-Veterinary and Biological Sciences, Saâd Dahlab University of Blida, PO Box 270, Road of Soumaâ, Blida, Algeria

[2] Nutrition Service, B43, Faculty of Veterinary Medicine, University of Liege, Sart Tilman B4000, Liege, Belgium

[3] University of Ouargla, BP 511, Route de Ghardaia, Ouargla (30000), Algeria.

[4] Department of Chemistry, Faculty of Science and Department of Biology, Faculty of Agro-Veterinary and Biological Sciences, Saâd Dahlab University of Blida, PO Box 270, Road of Soumaâ, Blida, Algeria

Abstract

The dromedary camel is able to produce meat and milk in arid conditions and its production is appreciated by the autochthon population. The aim of this study was to determine the selenium concentration in 61 *Longissimus dorsi* muscle samples representing three Algerian camel breeds (Tergui, Sahraoui or Naili breeds), the age of the selected camels ranged between 8 months and 13 years old. The muscle samples were collected from the slaughterhouse of Ouargla (South East Algeria) representing 41 males and 20 female. The average content of selenium was 0.216 $mg.kg^{-1}$ of wet tissue, which is higher than values currently reported in most ruminants. The level of Se was not influenced by age and sex. However, Tergui breed contained significantly higher selenium than other breeds, which may be due to diet composition intake.

In conclusion, the meat from camels in Algeria is a good source of selenium, assessing its nutritional interest for human.

Keywords: Algeria, camel, meat, selenium

***Corresponding author:** Dr Naima Sahraoui, tel: +213(0)772 393 243
Email: nasahraoui@gmail.com

Introduction

Camel meat is one of the main food resources for the autochthon population. Consumption of this type of meat is preferred for its organoleptic perception by many societies. This species is related to an environment with limited and random resources. In arid and semi-arid areas, this species is known for its resistance to thirst, heat and protein and mineral undernutrition (El Khasmi *et al*., 2005). The adaptation of camels to desert conditions results in a set of remarkable metabolic and physiological mechanisms. Resistance to mineral undernutrition is one aspect of this adaptation. Fundamental works carried out in recent years have deepened our knowledge on major and minor minerals metabolism (Bengoumi and Faye, 2000).

Such adaptation is the basis for the reputation of this species to be uniquely able, among other large mammals, to survive under desert conditions. One of the dromedary's mechanisms of adaptation to its natural habitat is changes in the activity of some minerals or trace elements, such as the selenium which is implicated in several vital functions.

Selenium in the diet is regarded as an essential trace element for human and animal nutrition (NAS, 1976). Amount in the body is closely related to its content in food, which depends on the geographical origin soil, soil pH and type of plants (Gierus *et al*., 2002). Selenium plays an important role as a potential antioxidant and its combination with vitamin E protects cells against oxygenated derivatives. It is also an essential compound for the metabolism of thyroid hormones, and therefore the survival of human newborns.

Selenium is a cofactor for glutathione peroxidase that protects lipids membrane against oxidation. It would also have anti-cancer factor by inhibiting the growth of cancer cells (Bourven and Mathieu, 2001).

However, the trace mineral in camel products such as meat are limited from clinical and biochemical point of views (Seboussi *et al*., 2004). In addition, there is very limited information on selenium concentration in camel meat, although deficiencies have been described in some parts of the world (Hamliri *et al*., 1990; Liu *et al*., 1994). This study aimed to determine selenium level in *Longissimus dorsi* muscle samples collected from three different Algerian dromedary camels representing two sexes and three age groups (0-4; 4-8 and more than 8 years of age). Age subgroups were defined according to the classification of Seboussi *et al*. (2004).

Material and Methods

Design of the experiment

Sixty-one camels were used representing three Algerian camel breeds (Tergui, Sahraoui and Naili).

Tergui was represented by 18 males (average age 6.9 years) and 6 females (average age 8.8 years), Sahraoui by 20 males (average age 3.1 years) and 14 females (average age 8.5 years) and Naili by 3 males (average age 7.6 years). The 61 animals randomly selected and divided into three age groups (0-4, 4-8 and above 8 years of age). The animals were raised on pastures containing essentially *Atriplex halimus, Artemisia herba alba, Stipa tenacissima* and other perennial plants. During wet years, the vegetation forms a good cover that allows the maintenance of herds. During the winter, the animals can exploit allomorphic pasture, and during the spring and summer, soft and dry vegetation can maintain camel herds for a long time.

Animals and analysis

This study was carried out at the slaughterhouse of Ouargla located in the South-Eastern of Algeria at 800 km from the capital Algiers.

Before slaughtering, a general examination of animals was carried out by a veterinarian. Healthy camels were used. The weights of carcasses were recorded. Samples of *Longissimus dorsi* muscle were dissected from each carcass and kept in labeled sterile plastic bags. The muscle samples were cut into cubes (3 cm) and approximately 100 g of each sample were milled for 1 minute using a robot and frozen at -20 °C until analysis. The muscle samples were subsequently lyophilized, mixed, sieved and then subsample was taken from each muscle sample. Selenium was determined by high performance liquid chromatography (HPLC) coupled with fluorimetry. The HPLC system is a device Thermo Separation Product (TSP) with a compound high-pressure pump which permits the use of a solvent (mobile phase: 90% cyclohexane, ethyl acetate 10%, flow 1 $mL.min^{-1}$) and isocratic pump with manual injection system (50 µL loop). The column is nonpolar S50DS2 C18-150A (150x4, 6 mm) coupled to Waters 474 fluorimeter. Excitation wavelength or absorbance piazsélénol: 378nm, emission: 530 nm. The retention time is 2.30 piazsélénol minutes, the samples were injected every 7 minutes

Statistical analysis

Ten samples of each muscle were individually analyzed and the selenium content of each food was expressed as mean± standard error.

The effect of sex and breed on the selenium content was statistically analyzed using age as covariate. The GLM model was used (GLM homogeneity of slopes and analysis of covariance ANCOVA) in Statistica 10, Statsoft Inc. Means were compared according to Student's t-test or one-way ANOVA. In cases of heterogeneity of variances or deviations from normality, a Kruskal-Wallis by ranks test was used. Differences were considered significant at $p<0.05$.

Results

The average selenium content in meat camel was 0.216±0.016 $mg.kg^{-1}$ (median 0.196, range 0.059-0.578). The effects of age, sex and breed on selenium concentration of *Longissimus dorsi* muscle are presented in Table 1.

Table 1. Content of selenium by breed for both sexes and age classes of camels, in Algeria (mean±SE, $mg.kg^{-1}$)

Age	Sex	Breed		p
		Tergui	Sahraoui	
0-4 years	Male	0,365±0,064	0,163±0,026	0,016
4-8 years	Male	0,258±0,001	0,159±0,091	0,475
	Female	0,231±0,016	0,164±0,029	0,281
	p	0,346	0,943	
>8 years	Male	0,303±0,012	0,227±0,148	0,697
	Female	0,223±0,019	0,157±0,030	0,160
	p	0,005	0,720	

Statistical significance (p) is in columns between males and females; in rows between Tergui and Sahraoui

The covariance analysis showed that there was no overall effect of sex and no overall effect of age. However, there was a significant effect of breed on selenium level ($p<0.05$, fig. 1).

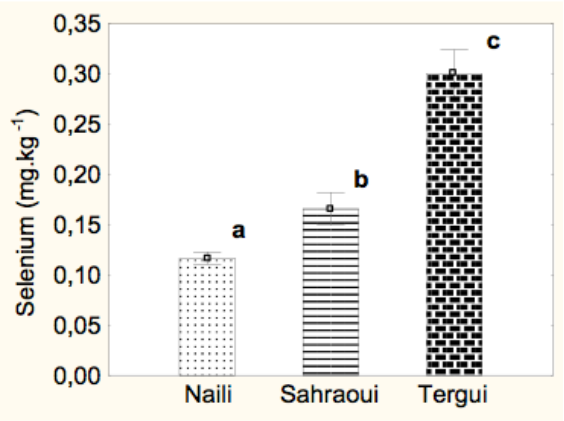

Figure 1. Selenium average levels for the three breeds of camels, in Algeria (mean±SE). Different letters show groups statistically different at $p<0.05$.

Student-tests confirmed that there was no significant difference between sexes on selenium level with the exception of Tergui breed. The Tergui males (above 8 years of age) had a significantly ($p<0.05$) higher level of selenium than females (0.303 vs. 0.223 $mg.kg^{-1}$).

In comparisons of mean levels of selenium by breed at different age and sex classes, Tergui males had a significantly ($p<0.05$) higher selenium content than Sahraoui males in 0-4 years group (0.365 vs. 0.163 $mg.kg^{-1}$).

Discussion

Although, selenium plays a vital role in mammals and is considered as an essential element, there is limited information on selenium concentration in camel meat (Hamliri, 1990; Bengoumi and *al*., 1998; El Qarawi and *al*., 2001; El Khouly and *al*., 2001; Seboussi and *al*., 2004; Liu and *al*., 1994).

However, selenium determination in organs has rarely been reported because it is of little clinical interest. In the wool of Bactrian camel from China, Liu *et al*. (1994) reported values between 140 and 190 $\mu g.kg^{-1}$, depending on their physiological status. Similar results, 190 to 210 $\mu g.kg^{-1}$, have been published by Ma (1995).

In the experiments of Faye and Seboussi (2008), Seboussi *et al*. (2008a, 2009a, 2009b) and Seboussi (2008b), on average, the highest total quantity of selenium was observed in the following order: in the liver (2727 µg), the kidney (807 µg), the lung (443 µg) and the heart (160 µg). Of course, a high quantity was also was observed in muscle (2,513 µg) (Faye and Seboussi, 2009).

In the zoo, selenium was added to the animal diets to eliminate deficiency (Kovac and *al*., 1996). Guetierrez *et al*. (2001) showed that uterine prolapses in the female of camel because of selenium

deficiency in the body. They also suggested that deficiencies in calcium, magnesium or selenium could increase the risk of prolapses in camel.

The present study showed that the range of selenium concentrate in Dromedary camel meat samples were from 57.8 μg.100 g^{-1} to 57.8 μg.100 g^{-1} wet tissue with an average value (21.6 μg.100 g^{-1}). AFSSA (2001) indicated that the selenium concentration was ranged from 6 to 14 μg.100 g^{-1} for meat, while Bauchart *et al*. (2008) found the range of selenium between 10 and 14 μg.100 g^{-1} for beef.

According to Faye and Bengoumi (2000), selenium plays a vital role in prevention of cancer in humans. When feed stuffs are deficient, the animal products such as milk or meat are also deficient for human. Guyot and *al*. (2007) and Buergelt and *al*. (1996) stated that deficiencies of selenium in livestock are widespread in Europe, with an impact on health, reproduction and production of the animals.

Therefore, the supplementation of animals with trace elements affects positively human health (Rasmussen and *al*., 2002; Hartikainen, 2005). The present study indicated that the Algerian camel is a good source of selenium for human diet.

Everything happens in camels as if its metabolism were oriented to anticipate periods of mineral undernutrition. It signed its adaptation to periods of food restriction by various mechanisms: increased absorption capacity during shortages, more storage capacity of certain minerals, more tolerance to certain electrolytes, maintaining enzyme activity despite deficit situations. Thus, the metabolism of this element is probably particular in camels (Faye and Bengoumi, 2000).

The major causes of selenium deficiency may be due to low levels of selenium in soil. Neve and Favier (1989) reported that concentration of selenium in animal tissues vary with the type of organ and depend on selenium intake and the chemical form of selenium.

The present study revealed that there was variation in selenium content between the camel breeds, but not between sexes or age groups.

However, Corbera *et al*. (2001) reported that the metabolic needs of selenium in the female dromedary seem higher than males regardless of their physiological status.

Nevertheless, Kadim and *al*., (2006) reported that age is therefore in important factor in determining camel meat quality and composition, which is also good source of

minerals. They confirmed also that camel meat is healthy and nutritious as it contains low fat as well as being a good source of minerals. Age is an important factor in determining meat quality and composition, and there was a general trend that mineral content of camel meat increased with age.

In addition, no effects related to age or sex was reported. Similar figures were identified by Liu and *al*. (1994) in China with concentrations ranging from 97 to 112 $ng.ml^{-1}$. Whereas, Ma (1995) suggested higher values of Se content 274-288 $ng.ml^{-1}$ but without specifying whether he worked on serum or whole blood.

Selenium metabolism in camel was not well known and few references were available. Up to date, no selenium effect for age or sex in meat was found in literature.

Conclusion

This study evaluated the concentration of selenium in Algerian camel meat. The Algerian dromedary camel meat contained a reasonable amount of selenium, which can encourage its consumption. The camel meat can be used to reduce or eliminate selenium deficiency in human by consumption camel meat.

References

AFSSA, 2001. *Apports nutritionnels conseillés pour la population française*. Tec & Doc, 3e édition, Paris.

AL-Qarawi A.A., Abbas B., Haroun E.M., Mahmoud O.M., Alhawas A., 2001. *Clinicopathological investigation of selenium responsive myopathy in young adult camels*. J.Camel Pract. Res., 8, 23-27.

Bauchart D., Chantelot F., Gandemer G., 2008. *Qualités nutritionnelles de la viande et des abats chez le bovin: données récentes sur les principaux constituants d'intérêt nutritionnel*. Cahiers de Nutrition et de Diététique., Vol 43, HS1, p. 29-39.

Buergelt C.D., Sisk D., Chenoweth P.J., Gamboa J., Nargus R., 1996. *Nutritional myodegeneration associated with dorsal scapular displacement in beef heifers*. J. Camp. Path, 114, 445-450.

Bengoumi M., Essamadi K., Tressol J.C., Faye B., 1998. *Comparative study of copper and zinc metabolism in cattle and camel*. Biol. Trace Elem. Res , 63, 81-94.

Bengoumi M., Faye B., 2000. *Adaptation du dromadaire à la déshydratation*. Revue Sécheresse 13, 121–129.

Bourven I., Mathieu H., 2001. *Étude d'une méthode de dosage du*

sélénium sérique par CLHP. Bull. Soc. Pharm. Bordeaux, 140, 7-18.

Corbera J.A., Gutierrez C., Morales M., Montel A., Montoya J.A., 2001. *Assessment of blood glutathione peroxidase activity in the dromedary camel*. Vet. Res., 32, 185-191.

El Khasmi M., Riad F., Safwate A., El Abbadi N., Farh M., Faye B., Coxam V., 2005**.** *La chamelle allaitante face au stress calcique: une fonction endocrine adaptée aux conditions désertiques*. Sécheresse, 16, 261-267.

El Khouly A.A., Abbas T.A., Moustafa T., 2001. *Myocardiol dystrophy in camel calves in the United Arab Emirates (field cases)*. Emir. J. Agric. Sci., 13, 11-17.

Faye B., Bengoumi M., 2000. *Le dromadaire face à la sous-nutrition minérale: un aspect méconnu de son adaptabilité aux conditions désertiques*. Science et Changements Planétaires / Sécheresse, 11, 3, 155-61.

Faye B., Seboussi R., 2008. *Experimental selenium intoxication in camel*. Veterinaria 2008, 3, 18-29.

Faye B., Seboussi R., 2009. *Selenium in Camel – A Review*. Nutrients 2009, 1, 30-49.

Gierus M., Schwarz F.J., Kirchgessner M., 2002. *Selenium supplementation and selenium status of dairy cows fed diets based on grass, grass silage or maize silage*. J. Anim. Physiol. Anim. Nutr., 86, 74-82.

Guetierrez C., Corbera J., Morales I., Morales M., Navarro R., 2001. *Uterine prolapse in 2 dromedary camels*. Can. Vet. J., 42, 803-804.

Guyot H., Spring P., Andrieu S., Rollin F., 2007. *Comparative responses to sodium selenite and organic selenium supplements in Belgian Blue cows and calves*. Livestock Science, 111, 259-263.

Kadim I.T., Mahgoub O., Al Marzooqi W., Al –Zadgali S., Annamali K., Mansour M.H., 2006. *Effects of age on composition and quality of muscle Longissimus thoracis of the Omani Arabian camel (Camelus dromedaries)*. Meat Sci.,73, 619 -625.

Hamliri A., Olson W.G., Johnson D.W., Kessabi M., 1990. *Evaluation of biochemical evidence of congenital nutritional myopathy in the two-week prepartum fetuses from selenium-deficient ewes*. J. Am. Vet. Med. Assoc., 51, 1112-5.

Hartikainen H., 2005. *Biogeochemistry of selenium and its impact on food chain quality and human health*. J. Trace Elem. Med. Biol., 18, 309-318.

Kovac G., Michena A., Bartko P., Reichel P., Mudroc P., Seidel H., 1996. *An outbreak of nutritional*

muscular dystrophy in camels (Camelus dromedaries) in Kosice zoo. Folia. Vet., 40, 33-37.

Liu Z.P., Ma Z., Zhang Y.J., 1994. *Studies on the relationship between sway disease of bactrian camels and copper status in Gansu Province*. Vet. Res. Comm., 18, 251-60.

Ma Z., 1995. *Studies of sway disease of Chinese bactrian camels. Epidemiological and aetiological aspects*. Report of International Foundation for Science Project, Stockholm, Sweden, 17 p.

NAS, 1976. *Selenium*. Washington, DC, National Academy of Sciences.

Neve J., Favier A., 1989 eds. *Selenium in Medicine and Biology*, Walter de Gruyter, New York , 315-320, 15.

Rasmussen L.B., Ovesen L., Bulow I., Jorgensen T., Knudsen N., Laurberg P., Pertild H., 2002. *Dietary iodine intake and urinary iodine excretion in a Danish population: effect of geography, supplements and food choice*. Br. J. Nutr., 87, 61-69.

Seboussi R., FayeB., AlhadramiG., 2004. *Facteurs de variation de quelques éléments trace (sélénium, cuivre, zinc) et d'enzymes témoins de la souffrance musculairedans le sérum du dromadaire (Camelus dromedarius) aux Emirats Arabes Unis*. Rev. Elev. Med. Vét. Pays Trop., 57 (1-2), 87-94.

Seboussi R.; Faye B.; Alhadrami G.; Askar M.; Ibrahim W.; Hassan K.; Mahjoub B., 2008a. *Effect of different selenium supplementation levels on selenium status in camel*. Biol. Trace Elem. Res., *123*, 124-138.

Seboussi R., 2008b. *Métabolisme du sélénium chez le dromadaire*. Thèse en zootechnie. Centre international d'études supérieures en sciences agronomiques (Supagro) de Montpellier: Montpellier, France, p. 292.

Seboussi R.; Faye B.; Askar M.; Hassan K.; Alhadrami G., 2009a. *Effect of selenium supplementation on blood status and milk, urine and fecal excretion in pregnant and lactating camel*. Biol. Trace Elem. Res., *128*, 45-57.

Seboussi R.; Faye B.; Alhadrami G.; Askar M.; Bengoumi M.; Elkhouly A., 2009b. *Chronic selenosis in camel*. J. Camel Pract. Res., in press.