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ORIGINAL ARTICLE

# Amino acids content and electrophoretic profile of camel milk casein from different camel breeds in Saudi Arabia

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**Abstract** This study aimed to evaluate amino acids content and the electrophoretic profile of camel milk casein from different camel breeds. Milk from three different camel breeds (Majaheim, Wadah and Safrah) as well as cow milk were used in this study.

Results showed that ash and moisture contents were significantly higher in camel milk casein of all breeds compared to that of cow milk. On the other hand, casein protein of cow milk was significantly higher compared to that of all camel milk breeds. Molecular weights of casein patterns of camel milk breeds were higher compared to that of cow milk.

Essential (Phe, Lys and His) and non-essential amino acids content was significantly higher in cow milk casein compared to the casein of all camel milk breeds. However, there was no significant difference for the other essential amino acids between cow casein and the casein of Safrah breed and their quantities in cow and Safrah casein were significantly higher compared to the other two breeds. Non-essential amino acids except Arg and the essential amino acids (Met, Ile, Lue and Phe) were also significantly higher in cow milk α-casein compared to α-casein from all camel breeds. Moreover, essential amino acids (Val, Phe and His) and the non-essential amino acids (Gly and Ser) content was significantly higher in cow milk β-casein compared to the β-casein of all camel milk

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breeds and the opposite was true for Lys, Thr, Met and Ile. However, Met, Ile, Phe and His were significantly higher for β-casein of Majaheim compared to the other two milk breeds. The non-essential amino acids (Gly, Tyr, Ala and Asp) and the essential amino acids (Thr, Val and Ile) were significantly higher in cow milk κ-casein compared to that for all camel milk breeds. There was no significant difference among all camel milk breeds in their κ-casein content of most essential amino acids.

Relative migration of casein bands of camel milk casein was not identical. The relative migration of $\alpha_s$-, β- and κ-casein of camel casein was slower than those of cow casein. The molecular weights of $\alpha_s$-, β- and κ-casein of camel caseins were 27.6, 23.8 and 22.4 KDa, respectively. More studies are needed to elucidate the structure of camel milk.



## 1. Introduction

Camels in Saudi Arabia play a major role in supplying the desert dwellers with milk of good nutritional quality under extremely hostile conditions of temperature, drought and lack of pasture (Yagil and Etzion, 1980). Camel milk contains all the essential nutrients found in bovine milk (El-Agamy et al., 1998; Karue, 1998) and consumed in Saudi Arabia as fresh and soured milk (Abu-Taraboush et al., 1998). Camels in Saudi Arabia can be classified into different ecotypes as Majaheim, Wadah, Safrahh, Malha, Hamra and Omani among others (Bhattacharya, 1988; Elamin and Wilcox, 1992; Saoud et al., 1988). The average camel milk yields of Majaheim, Wadah and Safrah were 3896, 2336 and 2236 kg per lactation, respectively (Saoud et al., 1988).

Casein makes up about 80% of cow milk proteins (Hipp et al., 1952), while the casein content of camel milk is 52–87% as reported by Al haj and Al-kanhal (2010). The principal casein fractions for cow are $\alpha s_1$-, $\alpha s_2$-, β- and κ-casein in ratio 4:1:4:1 (Walstra et al., 1984) and the numbers of amino acid residues in these four casein fractions were 199, 207, 209, 169, respectively as compared to 207, 178, 217 and 162, respectively for camel casein as reported by Kappeler et al. (1998).

Dromedary milk and bovine milk had similar amino acid composition, however, Gly and Cys were significantly lower in dromedary milk casein compared to that in bovine milk (Farah and Rüegg, 1989). Sawaya et al. (1984) reported also that camel milk was rich in sulfur amino acids. Camel milk casein contained most of the essential amino acids in high ratios. Glu was the most abundant amino acid followed by Leuc, Lys and Asp (Abu-Tarboush and Ahmed, 2005). The amino acids of casein fractions were found to be similar between camel milk casein and cow milk casein Larsson-Raznikiewicz and Mohamed (1986). Breeds of camel could have affected in the amino acid composition of casein, therefore the aims of this study were to determine the amino acids content and the electrophoretic profile of camel breeds (Majaheim, Wadah and Safrah) milk casein and compare it with cow milk casein.

## 2. Materials and methods

### 2.1. Milk samples

Milk samples were taken from each female dromedary Majaheim, Wadah and Safrah camels in the afternoon milking. Samples were collected from Prince Abdulaziz bin Fahd Farm, Riyadh in the central region of Saudi Arabia. The feeding regime was approximately the same for all camels in the farm. The samples collected were immediately refrigerated and transferred to the laboratory. For comparison, bulk cow milk of Friesian breed, obtained from Al-Azizia Farm, Al-Kharj governorate, was used.

### 2.2. Acid casein preparation

Acid casein was prepared from raw skim milk of Majaheim, Wadah and Safrah camels and cow according to the modified method of Shammet et al. (1992). Briefly Skim milk was acidified to pH 4.6 with 1 M HCl. Casein precipitate was washed three times with water, then redissolved in NaOH 1 M at pH 7.0, reprecipitated at pH 4.6, and the precipitated casein washed further for two times with water. The caseins were freeze dried.

### 2.3. Proximate analysis

Samples of casein fractions were analyzed for ash, moisture and protein according to the procedures outlined in AOAC (1995).

### 2.4. Separation of casein fractions

Casein fractions α-, β- and κ-caseins were separated by the methods of Hipp et al. (1952), Aschaffenburg (1963), and Girdhar and Hansen (1978).

### 2.5. Amino acid analysis

Acid hydrolysis (6 N HCl) for the freeze-dried casein samples was performed according to AOAC (1995) method, then amino acid analysis was performed on reverse phase high pressure chromatography (Shimadzu LC-10 AD, Shimadzu Corporation, Kyoto, Japan). Samples were analyzed on Shimpack amino-Na type column (10 cm × 6.0 mm) obtained from Shimadzu Corporation. The amino acids of samples were derivatized with *O*-phthadialdehyde (OPA) detected by Fluorescent detector and data were integrated using an integrator model C-R7A (Shimadzu chromatopac data processor).

### 2.6. Polyacrylamide gel electrophoresis (SDS–PAGE)

Samples of caseins were separated using a polyacrylamide gel according to the procedures of Pharmacia instruction No. 80-1310 (1993) using a Pharmacia unit (Pharmacia, fine