Health effect of camel milk: commercial argument or scientific truths

Dr. Omar Alhaj

Associate professor
Head of Nutrition Department
University of Petra
INTRODUCTION

The primary purpose of food including dairy products is to provide nutrients to fulfil the body’s traditional requirements and other functions including cultural and social wellbeing.

It has long been recognized that some non-traditional foods, for example camel milk, fortified food and beverages that provide particular health benefits.

In recent decades, dairy products have been modified to provide disease-preventive attributes, beside to their particular functional health benefits.
FUNCTIONALITY OF CAMEL MILK

Historically, camel milk has been used for the treatment of many ailments including: tuberculosis, dropsy, asthma jaundice, leishmaniasis and respiratory insufficiency.

Camel milk considered as a functional food due to the presence of many bioactive ingredients. These bioactive compounds either naturally exist in camel milk including immunoglobulins, and other antimicrobial compounds.

Or those released upon digestion with proteolytic bacterial enzymes, and enzymatic hydrolysis whether at the in vivo or in vitro level.
FUNCTIONALITY OF CAMEL MILK

What is interesting about the bioactive compounds of camel milk is that some of them are stable upon heat treatment; even after sterilization and provide functionality such as: angiotensin converting enzyme (ACE)-inhibitory activity, antimicrobial, anticancer and antioxidant effect.

On the other hand, some of the bioactive compounds such as lactoferrin could be inactivated by lower temperatures such as pasteurization.
How to confirm such an effect

Health benefit(s) confirmed *in vitro* assays by probiotic strains must always be confirmed by *in vivo* trials for their final selection and to confirm their evaluation procedures (Morelli, 2007).

However, *in vitro* evaluation is not always a precise indicator for *in vivo* behavior.

For example, *Lactobacillus paracasei* demonstrated a limited acid tolerance *in vitro* assessment (Mishra and Prasad 2005; Schillinger *et al.* 2005) but shown to have promising results *in vivo* trials including healthy infants, adults and elderly subjects (Crittenden *et al.* 2002) and with rats fed milk containing probiotic bacteria.

This might be because bacteria can utilize the buffering capacity of the food and milk proteins to protect itself when exposed to gastric juice.
How to confirm such an effect

On the other hand, not all *in vitro* ACE-inhibitor peptides have shown to be effective *in vivo*, because some peptides might be degraded by gastrointestinal enzymes, blood serum and intracellular peptidase respectively or undergoes modification in the liver (Meisel *et al.* 2006).

Hence, all studies done *in vitro* need to be confirmed *in vivo* and vice versa to ensure their potential health benefits.
Angiotensin converting enzyme-inhibitory activity and antimicrobial effect of fermented camel milk (Camelus dromedarius)

OMAR A ALHAI,^1,6 ALI A METWALLI,^1,4 ELSAYED A ISMAIL,^1,3 HATEM S ALI,^1 ABDULRAHMAN S AL-KHALIFA^1 and ARA D KANEKANIAN^2

^1Department of Food Science & Nutrition, College of Food and Agricultural Sciences, King Saud University, P.O. Box 2460, Riyadh 11451, Saudi Arabia, ^2Centre for Nutrition, Dietetics and Food Science, Cardiff Metropolitan University, Cardiff Wales CF3 2YB, UK. ^3Department of Dairy Science, Faculty of Agriculture, Benha University, Benha 13311, Egypt, and ^4Dairy Department, College of Agriculture, Minia University, Egypt

This study aimed to determine the angiotensin converting enzyme-inhibitory activity and antimicrobial effect of fermented camel milk. Samples were prepared either using Lactobacillus acidophilus and Streptococcus thermophilus or Lactobacillus helveticus and Str. thermophilus and labeled as S1 and S2, respectively. The IC_{50} values of S1 and S2 samples ranged between 113–200 and 70–133 µg/mL, respectively. The antimicrobial effects of S1 and S2 samples against Bacillus cereus, Salmonella Typhimurium and Staphylococcus aureus were apparent after 12 h of incubation and continued until 15 days of storage, whereas unfermented camel milk exhibited no antimicrobial effects against any of the tested pathogens.

Keywords: Camel milk, Angiotensin converting enzyme, Antimicrobial effect, Bioactive peptides, Lactobacillus.
Table 1 ACE-I activity and IC₅₀ of water soluble permeate (WSP) from fermented camel milk during incubation and cold storage time. Standard deviations are given in brackets.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Time</th>
<th>IC₅₀ (µg/mL)</th>
<th>Sample</th>
<th>Time</th>
<th>IC₅₀ (µg/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incubation</td>
<td>S1</td>
<td>0 h</td>
<td>S2</td>
<td>0 h</td>
<td>144 (3.12)</td>
</tr>
<tr>
<td></td>
<td>S1</td>
<td>6 h</td>
<td>S2</td>
<td>6 h</td>
<td>118 (3.76)</td>
</tr>
<tr>
<td></td>
<td>S1</td>
<td>12 h</td>
<td>S2</td>
<td>12 h</td>
<td>102 (3.45)</td>
</tr>
<tr>
<td>Storage</td>
<td>S1</td>
<td>3 d</td>
<td>S2</td>
<td>3 d</td>
<td>174 (4.89)</td>
</tr>
<tr>
<td></td>
<td>S1</td>
<td>9 d</td>
<td>S2</td>
<td>9 d</td>
<td>113 (3.09)</td>
</tr>
<tr>
<td></td>
<td>S1</td>
<td>15 d</td>
<td>S2</td>
<td>15 d</td>
<td>133 (4.89)</td>
</tr>
</tbody>
</table>

IC₅₀: Concentration of an ACE-inhibitor (fermented and un-fermented camel milk) needed to inhibit 50% of ACE activity; S1: WSP of camel milk fermented with *Streptococcus thermophilus* and *Lactobacillus acidophilus*. S2: WSP of camel milk fermented with *S. thermophilus* and *L. helveticus*. 0 h: WSP from unfermented camel milk.
Figure 3 Changes in angiotensin converting enzyme-inhibitory (ACE-I) activity and free amino group concentration (OPA) of water soluble permeate (WSP) from S1 and S2 samples for up to 15 days. Zero hour represents WSP from unfermented camel milk. Error bars indicate the mean ± standard deviation of mean values (standard deviation). [Colour figure can be viewed at wileyonlinelibrary.com]
Table 2 Antimicrobial activity of water soluble extract (WSE) containing bioactive peptides isolated from fermented and unfermented camel milk against some pathogens.

<table>
<thead>
<tr>
<th>Pathogens</th>
<th>Bacillus cereus</th>
<th>Escherichia coli</th>
<th>Salmonella typhimurium</th>
<th>Staphylococcus aureus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inhibition zones</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample</td>
<td>S1</td>
<td>S2</td>
<td>S1</td>
<td>S2</td>
</tr>
<tr>
<td>0 h</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>12 h</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>3d</td>
<td>++</td>
<td>++</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>9d</td>
<td>++</td>
<td>+</td>
<td>-</td>
<td>++</td>
</tr>
<tr>
<td>15d</td>
<td>++</td>
<td>+</td>
<td>-</td>
<td>++</td>
</tr>
</tbody>
</table>

S1: WSE from camel milk fermented with *Lactobacillus acidophilus* and *Streptococcus thermophilus*; S2: WSE from camel milk fermented with *L. helveticus* and *S. thermophilus*; 0 h: WSE from unfermented camel milk. ++, very large inhibition zone (ca 14–16 mm); +, large inhibition zone (ca 11–13 mm); ±, medium inhibition zone (ca 8–10 mm); −, no inhibition zone.
Identification of potential ACE-inhibitory peptides from dromedary fermented camel milk

Omar Amin Alhaj

Department of Food Science and Nutrition, College of Food and Agricultural Sciences, King Saud University, Riyadh, Kingdom of Saudi Arabia

ABSTRACT

Camel milk is a good nutritional source for people living in the arid and urban areas. This study aim to identify ACE-inhibitory peptides from dromedary camel milk produced using Lactobacillus helveticus or Lactobacillus acidophilus. Ten ACE-inhibitory peptides were identified using HPLC-MALDI-TOF MS. L. helveticus strain was found superior in respect to production of ACE-inhibitory peptides, compared with L. acidophilus due to having high proteolytic activity. However, all identified amino acid sequences were corresponding to β-casein of camel milk (Camelus dromedarius). Furthermore, molecular mass of identified peptides were below 1200 Da. Some ACE-inhibitory peptides were found to remain stable for up to 15 d of storage.

ARTICLE HISTORY

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KEYWORDS

Camel milk; ACE-inhibitory peptides; probiotic; amino acid sequence

PALABRAS CLAVE

leche de camello; péptidos inhibidores de ACE;
<table>
<thead>
<tr>
<th>Established ACE-inhibitory peptides (a)</th>
<th>Identified peptides in fermented camel milk (b)</th>
<th>Camel β-casein</th>
<th>Starter culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>KVLVPVP</td>
<td>LSLSQFKVLVPVPQ</td>
<td>178–191</td>
<td>1</td>
</tr>
<tr>
<td>SLSQFKVLVPVPQ</td>
<td>SLSQFKVLVPVPQ</td>
<td>179–191</td>
<td>1</td>
</tr>
<tr>
<td>SQFKVLVPVPQ</td>
<td>SQFKVLVPVPQ</td>
<td>182–191</td>
<td>1</td>
</tr>
<tr>
<td>LHLPLP</td>
<td>TDLLENHLPLPL</td>
<td>144–155</td>
<td>1</td>
</tr>
<tr>
<td>DLENHLPLPL</td>
<td>DLENHLPLPL</td>
<td>145–155</td>
<td>1</td>
</tr>
<tr>
<td>LENLHLPLPL</td>
<td>LENLHLPLPL</td>
<td>146–155</td>
<td>1</td>
</tr>
<tr>
<td>AVPYPQR</td>
<td>KVLVPVPQQMVPYPQ</td>
<td>185–198</td>
<td>1</td>
</tr>
<tr>
<td>AVPYP</td>
<td>KVLVPVPQQMVPYPQ</td>
<td>185–198</td>
<td>1</td>
</tr>
<tr>
<td>PYP</td>
<td>KVLVPVPQQMVPYPQ</td>
<td>185–198</td>
<td>1</td>
</tr>
<tr>
<td>YQEPVLQPVVR</td>
<td>VLPFQEPVPDPVVR</td>
<td>206–219</td>
<td>2</td>
</tr>
<tr>
<td>TPVWPPPLQQP</td>
<td>VMVPFLQPK</td>
<td>98–107</td>
<td>2</td>
</tr>
</tbody>
</table>

(a) previously characterized as ACE-inhibitory peptides from bovine milk by Meisel et al. (2006); (b) sequences of identified peptides derived from fermented camel milk; underlined sequences in (b) correspond to those characterized in (a). 1: WSP from camel milk sample fermented with *L. helveticus* after 9 d of storage. 2: WSP from camel milk sample fermented with *L. acidophilus* after 9 d of storage.
Antihypertensive effect of fermented skin camel (Camelus dromedarius) milk on spontaneously hypertensive rats

Mohammed A. Yahya, Omar A. Almujtaba and Abdulrahman S. Al-Khalifah
Department of Food Science & Nutrition, College of Food and Agricultural Sciences, King Saud University, Riyadh, Saudi Arabia

Abstract

Background: Hypertension is one of the most common diseases in the world, thus prevention of hypertension is important in reducing the risks of cardiovascular disease. Milk contains bioactive peptides released during milk fermentation which lead to exhibit angiotensin I converting enzyme (ACE) inhibitory.

Objective: The aims of this study was to investigate the antihypertensive effect of fermented skin camel milk on rats and compared with unfermented skin camel milk as control.

Methods: The antihypertensive effect of fermented skin camel milk on thirty-six male spontaneously hypertensive rats (SHR) was carried out for short term and long term using different doses (60, 240 and 1,900 mg/kg body weight). Angiotensin converting enzyme (ACE) activity was also measured using ACE K1.

Results: The blood pressure systolic and diastolic of spontaneously hypertensive rats (SHR) in short term administration (24 hours) of 1,200 mg/kg body weight fermented skin camel milk decreased significantly (p < 0.05) from 22 to 36 mmHg and 29 to 32 mmHg, respectively, at four and eight hour of post administration. On the other hand, the blood pressure of fermented skin camel milk for long-term (20 days) decreased and affected the heart rate (beats/min). The lowest record of systolic (41 mmHg) and diastolic blood pressure (19 mmHg) were at dose of 1,900 mg/kg body weight of fermented skin camel milk at 15 days of administration. Likewise, ACE activity in plasma of SHR administered fermented skin camel milk decreased significantly (p < 0.05) compared with the control group.

Conclusion: The hypotensive effect of fermented skin camel milk by L. Arvelicus and S. thermophilus in SHR rats depends on the high dose of fermented skin camel milk in short and long term. The ACE activity inhibitory was close with fermented skin camel milk.
METHOD OF MAKING A FERMENTED
DAIRY PRODUCT FROM CAMEL MILK

Applicant: KING SAUD UNIVERSITY, Riyadh (SA)

Inventors: Omar Amin Alhaj, Riyadh (SA); Abdulrahman Saleh Al-Khalifa, Riyadh (SA); Ali Ahmed Metwalli, Riyadh (SA); Elsayed Ismail, Riyadh (SA); Hatem Salamah Ali, Riyadh (SA)

Assignee: KING SAUD UNIVERSITY, Riyadh (SA)

Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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Handbook of Research on

Health and Environmental Benefits of Camel Products

Omar Amin Alhaj, Bernard Faye, and Rajendra Prasad Agrawal
Have any Questions?