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Health effect of camel milk: commercial argument or scientific truths

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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.

Alhaj, O. A. (2020). In Handbook of research on health and environmental benefits of camel products.

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.

Alhaj, O. A. (2020). In Handbook of research on health and environmental benefits of camel products.

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.

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ORIGINAL RESEARCH

Angiotensin converting enzyme-inhibitory activity and antimicrobial effect of fermented camel milk (*Camelus dromedarius*)

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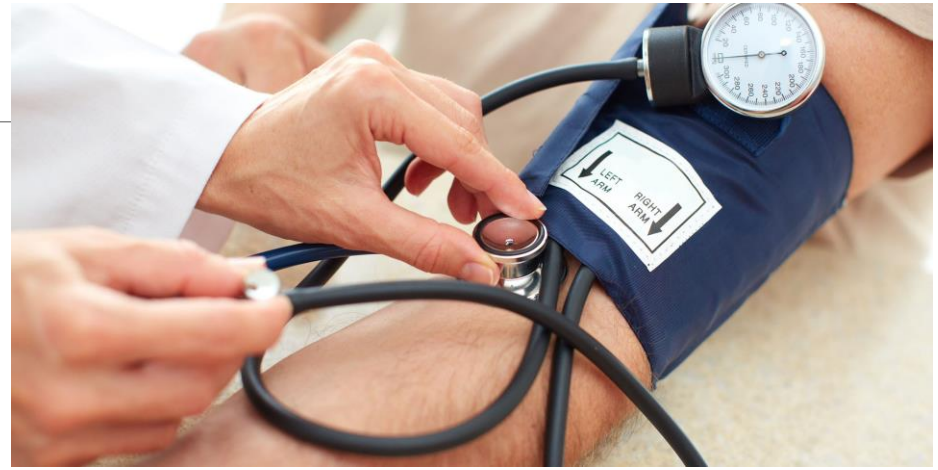
This study aimed to determine the angiotensin converting enzyme-inhibitory activity and antimicrobial effect of fermented camel milk. Samples were prepared either using Lactobacillus acidophilus *and* Streptococcus thermophilus *or* Lactobacillus helveticus *and* Str. thermophilus *and labelled as S1 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*.



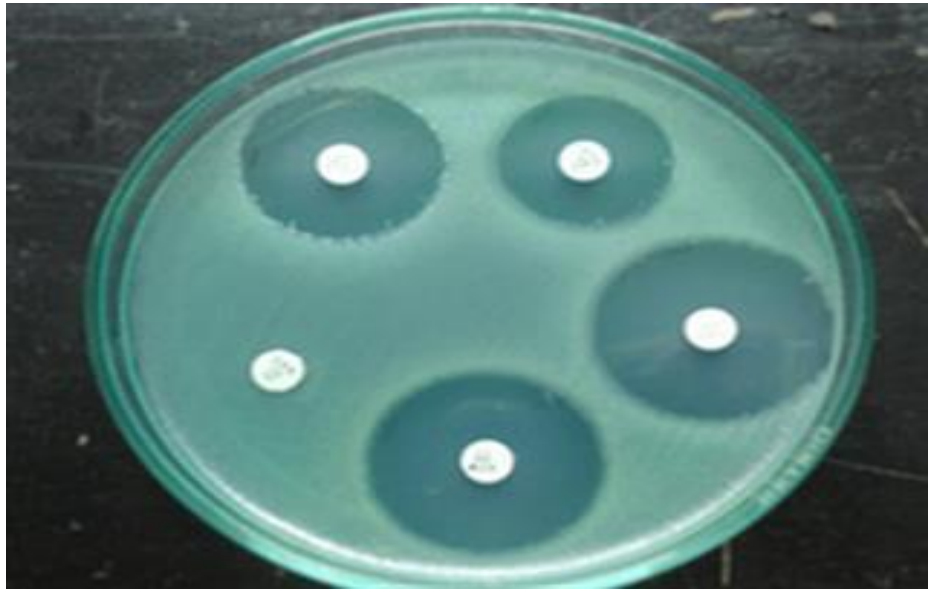


Table 1 ACE-I activity and IC_{50} of water soluble permeate (WSP) from fermented camel milk during incubation and cold storage time. Standard deviations are given in brackets.

	Sample	*Time*	*IC_{50} (μg/mL)*	*Sample*	*Time*	*IC_{50} (μg/mL)*
Incubation	S1	0 h	144 (3.12)	S2	0 h	144 (3.12)
	S1	6 h	118 (3.76)	S2	6 h	102 (3.45)
	S1	12 h	200 (5.46)	S2	12 h	80 (3.21)
Storage	S1	3 d	174 (4.89)	S2	3 d	96 (3.56)
	S1	9 d	113 (3.09)	S2	9 d	133 (4.89)
	S1	15 d	121 (2.34)	S2	15 d	70 (2.78)

IC_{50}: 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.

Alhaj et al. (2018). International Journal of Dairy Technology.

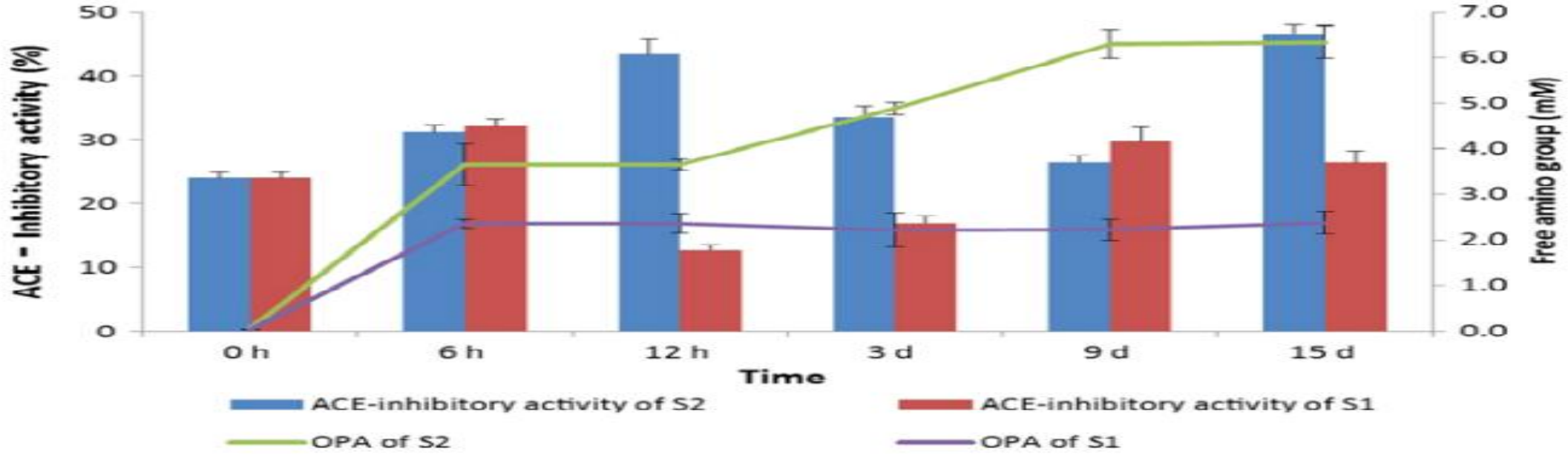


Figure 3 Changes in angiotensin converting enzyme-inhibitory (ACE-I) activity and free amino group concentration (OPA) of water soluble permeate (WSP) from S1 and S2 samples for up to 15 days. Zero hour represents WSP from unfermented camel milk. Error bars indicate the mean ± standard deviation of mean 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.

Pathogens	*Bacillus cereus*		*Escherichia coli*		*Salmonella typhimurium*		*Staphylococcus aureus*	
	Inhibition zones							
Sample	*S1*	*S2*	*S1*	*S2*	*S1*	*S2*	*S1*	*S2*
0 h	−	−	−	−	−	−	−	−
12 h	+	+	−	+	+	++	+	++
3d	++	++	−	+	±	++	+	++
9d	++	+	−	++	+	++	+	+
15d	++	+	−	+	+	++	+	++

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.

Alhaj et al. (2018). International Journal of Dairy Technology.

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Identification of potential ACE-inhibitory peptides from dromedary fermented camel milk

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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;

Tabla 1. Secuencias seleccionadas de (a) péptidos inhibidores de ACE de la actividad establecida liberada en las proteínas de la leche en comparación con (b) los péptidos relevantes caracterizados en la fermentación bacteriana de la leche de camello. Las secuencias de péptidos inhibidores de ACE potenciales encriptadas en (b) están subrayadas. Se presentan las posiciones de las secuencias de aminoácidos en caseína ß de camello.

Established ACE-inhibitory peptides (a)	Identified peptides in fermented camel milk (b)	Camel β-casein	Starter culture
KVLPVP	LSLSQFKVLPVPQ	178–191	1
	SLSQFKVLPVPQ	179–191	1
	SQFKVLPVPQ	182–191	1
LHLPLP	TDLENLHLPLPL	144–155	1
	DLENLHLPLPL	145–155	1
	LENLHLPLPL	146–155	1
AVPYPQR	KVLPVPQQMVPYPQ	185–198	1
AVPYP	KVLPVPQQMVPYPQ	185–198	1
PYP	KVLPVPQQMVPYPQ	185–198	1
YQEPVLQPVR	VLPFQEPVPDPVRG	206–219	2
	FQEPVPDPVR	208–218	2
TPVVVPPFLQP	VMVPFLQPK	98–107	2

(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.

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Nutrición Hospitalaria

Trabajo Original

Epidemiología y dietética

Antihypertensive effect of fermented skim camel *(Camelus dromedarius)* milk on spontaneously hypertensive rats

Efecto antihipertensivo de la leche de camello fermentada (Camelus dromedarius) *en ratas hipertensas*

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Abstract

Background: Hypertension is one of the most common diseases in worldwide, 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 aim of this study was to investigate the antihypertensive effect of fermented skim camel milk on rats and compared with unfermented skim camel milk as control.

Methods: The antihypertensive effect of fermented skim camel milk on thirty six male spontaneously hypertensive rats (SHR) was carried out for (short-term) and (long-term) using different doses (80, 240 and 1200 mg/kg body weight). Angiotensin converting enzyme (ACE) activity was also measured using ACE Kit.

Results: The blood pressure (systolic and diastolic) of spontaneously hypertensive rats (SHR) in short term administration (24 hours) of 1200 mg/kg body weight fermented skim camel milk decreased significantly ($p < 0.05$) from 22 to 36 mmHg and 28 to 32 mmHg, respectively, at four and eight hour of post administration. On the other hand, the blood pressure of fermented skim 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 1200 mg/kg body weight of fermented skim camel milk at 15 days of administration. Likewise, ACE activity in plasma of SHR administered fermented skim camel milk decreased significantly ($p < 0.05$) compared with the control group.

Conclusion: The hypotensive effect of fermented skim camel milk by *L. helveticus* and *S. thermophillus* in SHR rats depends on the high dose of fermented skim camel milk in short and long-term. The ACE activity inhibitory was clear with fermented skim camel milk.

Key words:

Hypertension. Skim camel milk. Blood pressure. Angiotensin I converting enzyme activity.

Yahya, *et al*. (2017). Nutricion hospitalaria

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(12) United States Patent

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(54) **METHOD OF MAKING A FERMENTED DAIRY PRODUCT FROM CAMEL MILK**

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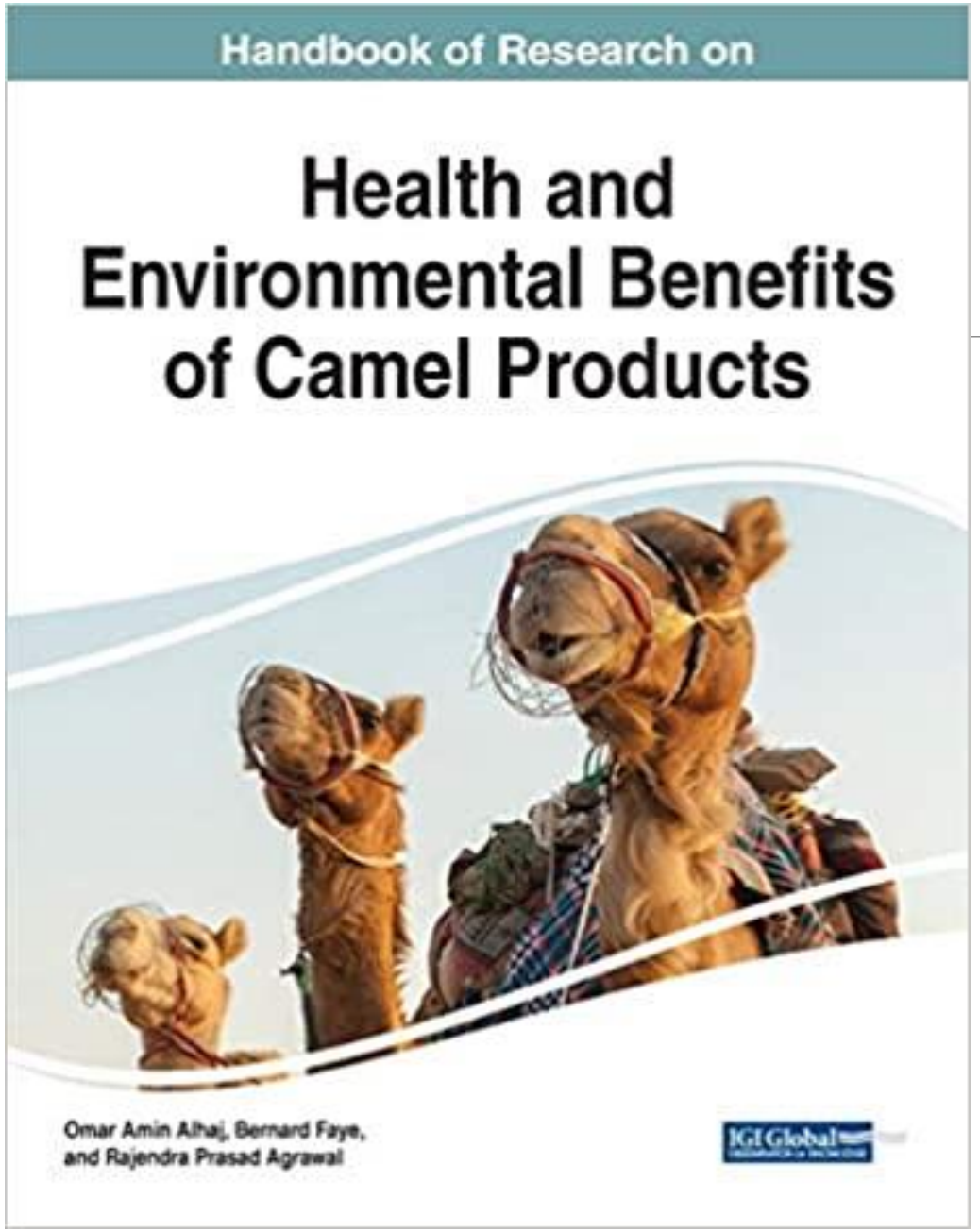
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