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Atractylodis macrocephalae Koidz

Wei Xu, Ran Guan, Yisong Lu, Xiaoyan Su, Ye Xu, Aifang Du and Songhua Hu*

Abstract

Background: Mastitis is considered the most significant and persistent disease in dairy cows, bringing about large economic losses. Subclinical mastitis brings about major cost implications, for it is difficult to detect due to absence of any visible indications and can persist in the mammary tissue throughout lactation. Immunomodulators have been widely used to reduce intramammary infections by modulating bovine mammary gland. *Atractylodis macrocephalae Koidz.* polysaccharides (*RAMP*), extracted from herbal medicine, has been used widely especially for its immunomodulatory function for many years. The objective of this study was to estimate an oil emulsified *Atractylodis macrocephalae Koidz.* polysaccharides (*RAMP-O*) as a potential therapeutic agent to treat subclinical mastitis by subcutaneous injection of *RAMP-O* in the area of supramammary lymph node in lactating cows via analysis of SCC, IMIs and NAGase.

Results: Injection of *RAMP-O* in the area of supramammary lymph node significantly reduced milk SCC and NAGase activity compared with control. The quarters with bacterial infection were also progressively reduced in *RAMP-O* treated cows and only 9 quarters were found to have bacterial infection, while no obvious change was found in the control group.

Conclusions: Subcutaneous injection of *RAMP-O* in the area of supramammary lymph node had therapeutic value in the treatment of bovine subclinical mastitis by reducing SCC, NAGase and IMIs in milk. Considering both the therapeutic effect and the cost of *RAMP-O*, 32 mg per dose was found most suitable to reduce milk SCC and NAGase. Therefore, *RAMP-O* deserves further study for its use in treatment of bovine mastitis.

Keywords: *Atractylodis macrocephalae Koidz*, Polysaccharides, Mastitis, Supramammary lymph node

Background

M . M , 10 . , 1–3 . . CC 1980 , D 11 - 4–7 . I C , 40–80 % . - , 900 -γ - 8 . *E che ichia coli S aph lococc* , *a e* IMI 12 . *Pana gin eng* C.A. M - 9 . I , 13–15 . I (G) A

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(IL-1α, IL-1β
F-α) 16, 17 .
A ac lodi mac ocephalae Koid . Com-
po i ae
C . I (*RAM*) -
C 2000 18 .
RAM , -
, 19 . -

RAM -
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(*RAMP*) *RAM*
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RAMP - -
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20–22 .
, *RAMP*
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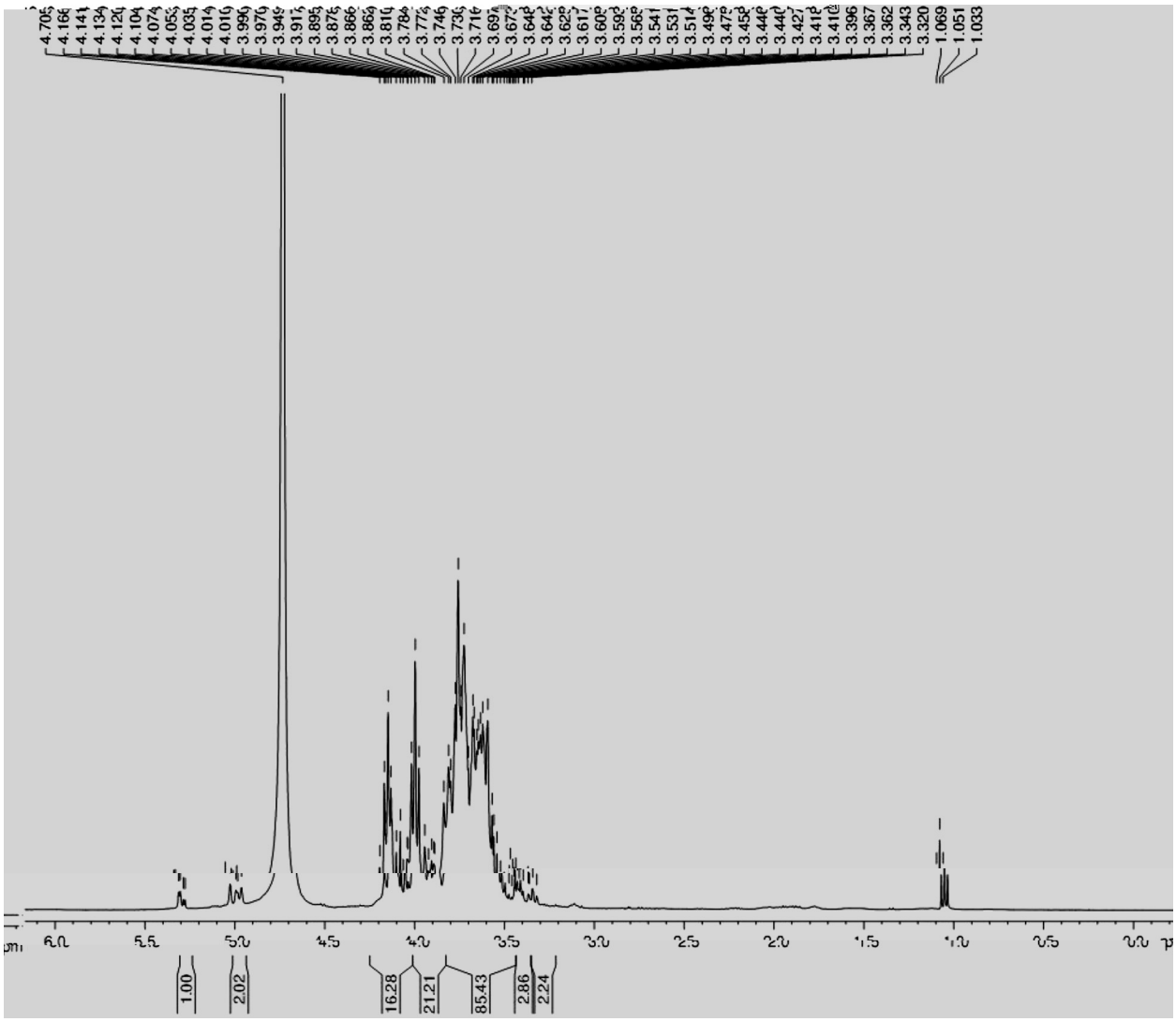

Fig. 2 ^{1}H NMR spectrum of *RAMP*. The ^{1}H NMR spectra showed that *RAMP* was a polysaccharide with both α and β configurations, while the β-configuration is dominant

4000 ; 7.8 0.4 , 7.6 0.3 8.1 0.4 , , 4,8 12 *RAMP* - , *RAMP-O* .

Irritation induced by subcutaneous injection of *RAMP-O* in the area of supramammary lymph node

I , 32 *RAMP-O* CC 220,000/ .

CC 3 (F . 3). A , - 1 2.

Simultaneous injections of *RAMP-O* in both left and right areas of the supramammary lymph node reduced SCC and NAGase activity in milk

I 1, (16), (32) (48) *RAMP-O* 1 3. D , CC AG 1 3 (1 2). A , - 2 3. C , CC 45.3 % 46.0 %, , 2 3; AG 55.2 % 60.3 %, , 2 3.

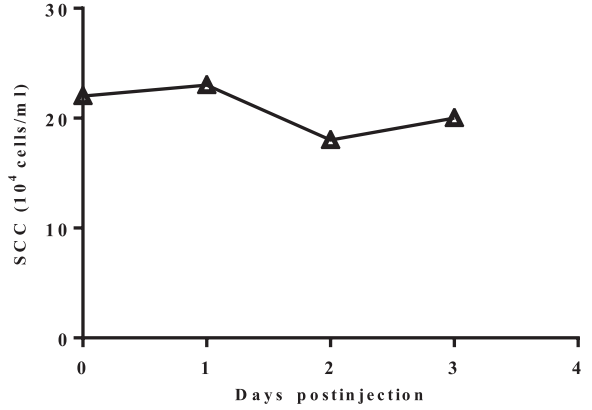

Fig. 3 Irritancy of *RAMP-O* on milk SCC. SCC of composite milk in cows before and after subcutaneous injection of *RAMP-O* in left and right areas of supramammary lymph node in cow 435

, 32 *RAMP-O*
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2. I -
RAMP-O (32) CC
AG (3 4). I , -
CC
(5).

Changes of bacteria infected quarters before and after treatment

B , 21
RAMP-O 23
(6).
2 . *S aph lococc a e* , *S ep ococc agalac iae*, *S ep ococc d galac- iae*, *S ep ococc be i* , - -
(C), . A ,
RAMP-O 9
,
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Discussion

I ,
A ac lodi mac o- cephalae K . (*RAMP-O*) -
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IL-2 *S aph lococc a e* IMI -
20–30 % 23 . G (G)
M
13–15 . ,
G IL-1α, IL-1β F-α
A 16, 17 . I
, -
RAMP-O . A *RAMP- O* , IMI
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RAMP *A ac lo- di mac ocephalae Koid* . -
. 24
Shen Ling Bai Zh San (, ,
, , , , , , -
, , ,)
96 %.
RAMP -
FMD 21, 25 . I 2013,
C
RAMP . ,
RAMP
. C
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2.49: 2.07: 4.94: 11.33: 1.35 21 . I ,
RAMP F I ^{1}H
M -
α- β- ,

Table 1 Influence of *RAMP-O* on composite milk SCC

RAMP-O (mg)	No. of cows	Weeks post treatment			
		0†	1	2	3
16	6	73.01 ± 10.05	65.79 ± 5.96	63.62 ± 17.94a*	54.65 ± 16.66a**
32	6	72.93 ± 18.42	62.31 ± 19.10	46.54 ± 25.14a	42.34 ± 21.30a*
48	6	71.48 ± 16.07	49.85 ± 23.49	45.01 ± 17.57A**	41.83 ± 14.81A*
Control	6	76.39 ± 14.38	77.20 ± 13.81	85.17 ± 12.15	77.47 ± 14.24

RAMP-O ( )
P *P*
**P* **P*
†

Table 2 Influence of *RAMP-O* on composite milk NAGase

RAMP-O (mg)	No. of cows	Weeks post treatment			
		0†	1	2	3
16	6	52.07 ± 12.50	46.75 ± 10.09*	46.31 ± 9.79*	33.91 ± 9.27a*
32	6	52.46 ± 12.24	46.18 ± 9.49*	25.36 ± 6.77A**	23.79 ± 5.47A**
48	6	52.11 ± 11.35	27.27 ± 8.09A**	24.97 ± 6.85A**	21.09 ± 3.44A**
Control	6	52.66 ± 12.12	52.90 ± 12.07	55.09 ± 11.73	53.13 ± 11.81

RAMP-O ( )

P *P*

P **P*

†

β- . -

M ,

26–28 . F CC

, . I CC

A agal memb anace 34 .

I ,

25, 29, 30 . *RAMP* *RAMP-O*

CC 1 2

RAMP-O . 32 48

RAMP-O *RAMP-O.* CC -

IMI

CC, AG IMI - *RAMP-O*

. 2.

M . I AG

-

31 . 35 . AG M

. A 36 .

, -

32 . M - . , M

AG IMI . A

. -

, AG 37 . I ,

- AG (2 4)

12 . CC

, , , - IMI *RAMP-O* .

, -

,

(M), , . 33 . I **Conclusions**

, A ,

RAMP-O

.

Table 3 Influence of *RAMP-O* on quarter milk SCC

Group	No. of quarters††	Weeks post treatment			
		0†	1	2	3
RAMP-O	14	63.39 ± 21.92	48.59 ± 27.52	40.18 ± 11.79a*	37.38 ± 11.36a*
Control	12	60.32 ± 10.20	54.53 ± 53.63	70.64 ± 67.24	64.37 ± 54.85

RAMP-O ( )

P

P *P*

†

††

CC, AG IMI . C -
RAMP-O, 32
CC
AG . , *RAMP-O*
.

Methods

Extraction of polysaccharide fraction of *Atractylodis macrocephalae Koidz.* polysaccharides *(RAMP)*

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C .
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, 3000
15 . F 95 %
, 4 C.
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M A D101,
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(- M 7000 D)
(*RAMP*,
- , 8.53). -
-

RAMP-O 1- -
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Irritancy test of *RAMP-O*

435
. E -
CC 500,000 /
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RAMP-O 32
.
3 CC .

Selection of cows

I
A C C -
-
I H
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J , ,
C , 2,000 H
- .
1 CC
500,000 / , 2
CC 500,000 / .

Experimental design

Experiment 1

A 24 H .
4 6
. G 1 3
RAMP-O
16, 32 48 ,
. E
. G 4
. C -
1, 2,
3 *RAMP-O*
CC AG .

Experiment 2

A 22 H
-
. 2
: 1 11 14 41
; 2 11 12
44 . G 1 -
RAMP-O (16)
RAMP-O
. 32
RAMP-O
RAMP-O
1
-
32 48 . G 2
.
1, 2, 3
RAMP-O , CC AG
. C
RAMP-O .

Estimation of somatic cell count (SCC)

F CC, 40–
42 C. A ,
F M (F E , H ,
D).

Bacteriological examination

M
37 C 24 48 . A -
, -
. A 3
.
A ,
18–24
37 C. F
, , -
M C 39, 40 .

N-acetyl-β-D-glucosaminidase test

M 3
AG
3,500 20 .
H 4.6 10 %
3,500 20 .
AG
(J B I , J ,
C) ,
D (37 C)
4- - - -β- -
AG
400 .
AG
1 15
37 C.

Statistical analyses

D 20.0 -
(.E.).
I -
RAMP-O
. - -
. C -

. P 0.05 -

.

Abbreviations

RAMP: *Atractylodis macrocephalae Koidz.* polysaccharides; *RAMP-O*: Oil emulsified *Atractylodis macrocephalae Koidz.* polysaccharides; SCC: Somatic cell count; IMIs: Intramammary infections; NAGase: N-Acetyl-β-D-glucosaminidase; CNS: Coagulase-negative staphylococci; GS: *Ginseng saponins*; FTIR: Transmission Fourier transform infrared spectroscopy; NMR: Nuclear magnetic resonance; PMN: Polymorphonuclear leukocyte.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

All authors participated in the draft of the manuscript. Moreover, WX, RG, YSL, XYS and XY carried out the sampling collection, microbiological isolation and biochemical identification; WX and YSL conducted the preparation of *RAMP-O*; WX and XYS performed statistical analysis; and SHH and AFD conceived, designed, and coordinated the study, and wrote the final manuscript. All authors read and approved the final manuscript.

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