Biomedical & Pharmacology Journal, June 2024. Vol. **17**(2), p. 1301-1306

Optimization of Snail (*Achatina fulica*) Mucus Gel Formula with CMC-Na as a Gelling Agent Healing Periodontitis

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https://dx.doi.org/10.13005/bpj/2943

(Received: 11 September 2023; accepted: 08 February 2024)

The content of snail (*Achatina fulica*) mucus chemical compounds that have been tested by researchers quantitatively are: Heparan Sulfate 16.45 mg/100 g, Acharan Sulfate 21.33 mg/100 mg, Acahtin isolate 36.06 mg/100 mg, Ca2+ Ion 86.12 mg/100 g, Beta Agglutinin 58.22 mg/100 g, Achasin Protein 102.22 mg/100 g, Glycokonyugat 8.86 mg/100 g, qualitatively snail mucus gel contains chemical substances contained in snail mucus gel are: Allantoin, Collagen, Elastin, Glicolic, Vit A and and C, Antibiotic peptide, Protein, Enzyme, Hyaluronic Acid, Copper Peptide, Antimicrobial peptide, Iron, Zinc, Proteoglycans. The purpose of this study was to obtain the optimal concentration of Na CMC as a gelling agent in the manufacture of snail mucus gel, obtain the optimal formula from the optimal formula variation, make a snail mucus gel preparation that serves as a cure drug for periodontitis, test snail mucus gel with optimum concentration in rats for the treatment of periodontitis. Research methods: true experimental laboratorium, determination, preparation of snail mucus chemical compounds, optimization and determination of Na CMC, optimization and determination of glycerin, optimization and determination of sodium lauryl sulfate and snail mucus preparation formula. The results of the study obtained optimization of gel preparations with three kinds of concentrations, namely 5%, 7.5%, and 10%, obtained the results of the stability test of the preparation declared stable, tasteless organoleptical viscous liquid, pH 6.75; 6.81; 6.88; 6.79; 6.79; 6.84 evenly distributed 5.6; 6.1; 6.5; 6.79; 6.79; 6.84; adhesion 12.45g/cm2; 15.80: g/cm2 ; 17.20; 12.50; 12.50;17.50; 17.20; 20.40; 15.40; 15.40; 20.05 viscosity 17.50; 17.20; 20.40; 15.40; 15.40; 20.05 cp and turbulent flow type (4050 Reynold), 4100; 4095; 4050; 4050; 4080. The conclusion of this research is the optimal concentration of Na CMC as a gelling agent in the manufacture of snail mucus gel is 10%.

Keywords: Healing; Na CMC; Optimization; Periodontitis; Snail Mucus Gel.

Gel is a semi-solid preparation and a soft mass made from small inorganic particles or micromolecules of organic compounds in the form of a suspension[1]. Gel is a semi-solid preparation and a soft mass made from small inorganic particles orbiter drug transfer when compared to ointment[2]. The selection of gelling agent will causes changes in the physical characteristics of the gel as well as the final result of the preparation. Gelling agents commonly used HPMC and and carbomer[3]. The use of snail mucus to heal burns can be facilitated by making it in the form of gel-like preparations. The gel has soothing properties, moisturizes, easy to use, easily penetrates the skin so that it provides a healing effect. Gel bases can be differentiated into hydrophobic gel bases and hydrophilic gel

bases[4]. In this study, optimization of snail mucus gel preparations was carried out with the addition of Na CMC as a gelling agent with different concentrations for each formula. This is intended to see the effect of increasing the concentration of CMC-Na used as a gelling agent on the physical stability of snail mucus. Snail mucus that has been obtained according to optimal optimization will be used as therapy in mice with dental periodontitis. Carboxymethylcellulose Sodium (CMC-Na) is in the form of a white granule powder, odorless, tasteless, and hygroscopic. At a vconcentration of 3-6% in the usual formula is used as a gel base. Not easily soluble in acetone, ethyl alcohol (95%), ether, and toluene, dispersible in water at all temperatures[5]. The content of snail mucus such as beta agglutinin (antibodies) in plasma (serum), achacin protein, glycoconjugates and acharan sulfate have the benefit of eliminating wounds in terms of the blood clotting process and proliferation of fibroblast cells[6]. The aim of this research was to determine the differences in the physical quality of snail (*Achatina fulica*) mucus gel preparations with differences in CMC-Na concentration as a gelling agent.

MATERIAL AND METHOD

The snail that used was the type of *Achatina fulica*. Snail mucus is taken using the tip of a pipette, touched on the abdomen, then the flowing mucus is accommodated in a sterile pot. The obtained mucus is yellowish in color and has a characteristic smell. Snail mucus gel is formulated with 3 different CMC-Na concentrations, namely F1(CMC-Na 5%), F2 (CMC-Na 7,5%), and F3 (CMC-Na 10%). The formulation of snail mucus gel preparation made by the CMC-Na method was developed by sprinkling on a mortar that has contained warm aquades and allowed to stand for 15 minutes (Mixture 1). Nipagin and nipasol in beaker glass are dissolved with alcohol using a stirring rod until homogeneous (Mixture 2). Mixture 1 is crushed until homongenic then put mixture 2 into mixture 1, grind until homogeneous. Add Propylene glycol to the mortar, mix until homogeneous. Put the Snail mucus in a mortar, stirring until homogeneous. Weigh, and adjust the weight of the preparation by adding aquadest to the preparation, stirring until homogeneous and put in a clean container, give it a label.

Organoleptic test is observed by color, odor (rancid or not)[7]. The homogeneity test is carried out with cream placed between 2 glass objects and then pay attention to level of rudeness particles or the presence or absence of homogenization under Light. If the color is evenly distributed and there are no fine grains in the preparation of the cream / ointment is said to be homogeneous[8]. Dispersion test: the dispersion test is said to be good (evenly distributed) in the range: 5-7 cm. The purpose of dispersion testing is to determine the ability of the speed of spread of the cream on the skin when applied to the skin[9]. Flow type: In laminar flow, the Reynolds number (Re) < 2100. As for turbulent flow, the Reynold number (Re) > 4000. Flows with Reynolds number between laminar and turbulent flows are referred to as transition flows. Adhesion: the adhesion test shows the higher the adhesion test the better. A gel adhesion test was carried out to be able to describe the preparation attached to the skin[10]. The general property of gel preparations is that they are able to adhere to the surface of the place of use for a long time before the preparation is washed or cleaned. Viscosity: good viscosity test ranges from 10-20 cps (centipoli)[9].

RESULTS

After qualitative analysis at the Oral Biology Laboratory, Faculty of Dentistry, Universitas Airlangga Surabaya, it was found that the chemical substances contained in snail mucus gel are: Allantoin, Collagen, Elastin, Glicolic, Vit A and and C, Antibiotic peptide, Protein, Enzyme, Hyaluronic Acid, Copper Peptide, Antimicrobial peptide, Iron, Zinc, Proteoglycans.

Results of Snail Mucus Gel Analysis (F1)

Table 3 shows that the results of snail mucus gel analysis with a concentration of 5% found that the stability is stable, viscous liquid, tasteless liquid, homogeneous, pH 6.75, even distribution 5.6 (normal dispersion is between 5-7 cm), adhesion 12.45, the higher the adhesion test the better, viscosity 17.50, ranging from 10-20 Centi poly and this is still within normal limits, while the tubulen flow type 4050 Reynold,

shows that snail mucus has a good flow type with Re>4000.

Results of Snail Mucus Gel Analysis (F2)

Table 4 shows that the results of snail mucus gel analysis with a concentration of 7.5% found that the stability is stable, viscous liquid, tasteless liquid, homogeneous, pH 6.81, even distribution 6.1 (normal dispersion is between 5-7 cm), adhesion 15.80, the higher the adhesion test the better, viscosity 17.20 (ranging from 10-20 Centi poly) and this is still within normal limits, while the tubulen flow type 4100 Reynold, shows that snail mucus has a good flow type with Re>4000. The percentage of snail mucus gel is 7.5% better than snail mucus gel with a concentration of 5%.

Fig. 1. Snail (*Achatina fulica*) mucus gel

Results of Snail Mucus Gel Analysis (F3)

Table 5 shows that the results of snail mucus gel analysis with concentration 10 % found that the stability is stable, viscous liquid, tasteless liquid, homogeneous, pH 6.88, even distribution 6.5 (normal dispersion is between 5-7 cm), adhesion 15.80, the higher the adhesion test the better, viscosity 20.40, ranging from 10-20 Centi poly and this is still within normal limits, while the tubulen flow type 4095 Reynold, shows that snail mucus has a good flow type with Re>4000. Three formulas of snail mucus gel were analyzed, a gel with a concentration of 10% has the best quality. Based on the results of testing the physical stability of the gel, the concentration of 10% will be used as a gel formula for healing periodontitis.

DISCUSSION

Periodontitis is a chronic inflammation of the tissue supporting the teeth (periodontium). Clinical examination of periodontitis sufferers shows an increase in pocket depth, bleeding when probing gently at the site of active disease and changes in physiological contours. Periodontitis is the main cause of tooth loss in adult population worldwide, who are at risk of loss multiple teeth, and masticatory dysfunction thereby affecting nutrition, and a person's quality of life[11]. On clinical

Fig. 2. Snail (*Achatina fulica*) mucus gel formula with 3 different CMC-Na concentrations

Table 1. Stability Test Results

Stability Test	Condition
Accelerated Stability Test	40^0C±2^0C/75% RH±5%RH
Intermediate Stability Test (Inyermediet testing)	30^0C±2^0C/65% RH±5%RH
Long-term Stability Test or actual test (Long term testing)	25^0C±2^0C/60%RH±5%RH or 2^oC/65%±RH

Table 2. Snail Mucus Gel Formula

No	Materials	F1 (%)	F2(%)	F3 (%)
1	CMC	5	7.5	10
2	Nipagin	0,36	0,36	0,36
3	Nipasol	0,04	0,04	0.04
4	PG	10	10	10
5	Aq ad.	100	100	100

Snail mucus gel was formulated with ingredients CMC, Nipagin, Nipasol, PG and Aquadest with concentrations of 5%, 7.5% and 10%.

examination there is an increase in probing depth, bleeding on probing (where the disease is active) which is carried out slowly and physiological contour changes can also be found redness, swelling of the gingiva and are usually painless[12]. In this study it was found that the concentration of snail mucus gel 10% is the best as a healing agent for periodontitis because it has stable stability, viscous liquid, tasteless liquid, homogeneous, pH 6.88 evenly distributed, 6.5, for normal dispersion is between 5-7 cm, adhesion 15.80, the higher the

Table 3. F1 Analysis Results

No	Test Code	Unit	Method	FI Results
1	Stability	-	Spectrometric test	Stable
2	Evaluation ofthe state	-	In house	Viscous liquid
3	Organoleptics	-	Organoleptics test	Tasteless liquid
4	Homogeneity	-	Spectrometric test	Homogeneous
5	pH	-	pHmetric test	6.75
6	Dispersion	-	Spectrometric test	Evenly distributed (5.6 cm)
7	Adhesion	g/cm^2	Brinel test	12.45
8	Viscosity	cp	Viscosimetrie test	17.50
9	Flow type	-	In House	Turbulent (4050 Reynold)

Table 4. F2 Analysis Results

No	Test Code	Unit	Method	F2 Results
1	Stability	-	Spectrometric test	Stable
2	Evaluation of thestate	-	In house	Viscous liquid
3	Organoleptics	-	Organoleptics test	Tasteless liquid
4	Homogeneity	-	Spectrometric test	Homogeneous
5	pH	-	pHmetric test	6.81
6	Dispersion	-	Spectrometric test	Evenlydistributed (6.1 cm)
7	Adhesion	g/cm^2	Brinel test	15.80
8	Viscosity	cp	Viscosimetrie test	17.20
9	Flow type	-	In House	Turbulent (4100Reynold)

Table 5. F3 Analysis Results

No	Test Code	Unit	Method	F3 Results
1	Stability	-	Spectrometric test	Stable
2	Evaluation of the state	-	In house	Viscous liquid
3	Organoleptics	-	Organoleptics test	Tasteless liquid
4	Homogenitas	-	Spectrometric test	Homogeneous
5	pH	-	pHmetric test	6.88
6	Dispersion	-	Spectrometric test	Evenly (6.5 cm)
7	Adhesion	g/cm^2	Brinel test	17.20
8	Viscosity	cp	Viscosimetrie test	20.40
9	Flow type	-	In House	Turbulent (4095Reynold)

adhesion test the better, viscosity 20.40, ranging from 10-20 Centi poly and this is still within normal limits, while the tubulen flow type 4095 Reynold, shows that snail mucus has a good flow type with Re >4000.

The gel is quite comfortable when used, gives a cooling sensation and can moisturize the skin because it has a high water content. The main gelling agent is also called gelling agent[13]. Gelling agent is a hydrocolloid substance that gives consistency to the gel. One example of a gelling agent is CMC-Na, a synthetic polymer of acrylic acid, in the form of a white powder with a characteristic odor, very easily ionized, slightly acidic, and very hygroscopic so that it has a good water-binding ability and can form a gel with sufficient viscosity[14]. The pharmaceutical formulation that is widely used orally and topically is Sodium Carboxymethyl cellulose (CMC-Na) especially because it can increase its viscosity properties. CMC-Na concentration for use of gelling agent is 3-6%. CMC-Na is also used in cosmetics, toiletries, surgical prosthetics, and incontinence, personal hygiene, and food products[15]. CMC-Na is in powder or granular form, white to cream in color, and hydroscopic[9]. Na CMC dissolves easily in hot and cold water. Na CMC is a derivative of Cellulose which provides stability to the product by capturing water to form hydrogen bridges with other Na CMC molecules[16]. The higher the gelling agent concentration, the higher the viscosity and the healing time is longer. Snail slime gel with gelling agent CMC-Na concentration of 3% and positive control (bioplacenton) has the fastest effect in healing burns, namely 12.50 ± 0.55 days compared to gelling agent CMC-Na concentration 5%, concentration 7%, control negative (snail slime), and base control[17]

CONCLUSION

The physical stability of the snail slime gel has been analyzed, it was found that the gel with an optimum concentration of 10% CMC-Na (F3) had the best quality. This concentration will be used as a formula for making periodontitis healing gel, because it has stable stability, thick liquid, tasteless liquid, homogeneous, pH 6.88, even distribution 6.5 (normal spreading power is between 5-7 cm), adhesive power 15.80 (the higher the better), the viscosity is 20.40 (still within normal limits), while the tubulent flow type is 4095 Reynold, indicating that snail mucus has a good flow type with Re>4000.

ACKNOWLEDGMENT

This research is supported and funded by the DIPA Poltekkes Kemenkes Denpasar, in 2022-2023.

Conflict of Interest

The author declares that there are no conflicts of interest.

Funding Sources

There are funding by DIPA Poltekkes Kemenkes Denpasar No. 5034. DDC.007.054.A.521219

REFERENCES

1. Depkes RI. Farmakope Indonesia, Edisi IV. Departemen Kesehatan Republik Indonesia. Jakarta, 2014.
2. Mardiana, Amila, and Lanny. Formulasi Gel yang Mengandung Lendir Bekicot (*Achatina fulica*) Serta Uji Aktivitas Antibakteri Terhadap *Propionibacterium acne*. UNISBA, 2015; pp. 223-224.
3. Arikumalasari, J., Dewantara, I. G. N. and Wijayanti, N. P. A, Optimasi HPMC Sebagai Gelling Agent dalam Formula Gel Ekstrak Kulit Buah Manggis (*Garcinia mangostana* L.), *Jurnal Farmasi Udayana*, 2009; 2 (3): 145–152.
4. Hariningsih, Y. Pengaruh Variasi Konsentrasi Na-CMC Terhadap Stabilitas Fisik Gel Ekstrak Pelepah Pisang Ambon (*Musa paradisiaca* L.). *Jurnal Ilmiah Farmasi*, 2019; 8 (2): 46-51.
5. Rowe RC. *Handbook of Pharmaceutical Excipients*; Six Edition. American Pharmacists Association: Pharmaceutical Press, 2009.
6. Putra MA. Effektifitas Pemberian Lendir Bekicot (*Achatina fulica*) dan Sediaan Krim 5% Terhadap Lama Penyembuhan Luka Bakar Secara Invivo. Indonesian Nursing Student Journal ,2015;Vol.3(1): 52-63.
7. Herawati H. Potensi Hidrokoloid Sebagai Bahan Tambahan Pada Produk Pangan dan non pangan Bermutu, *Jurnal Penelitian dan Pengembangan Pertanian*, 2018; 37 (1): 17–25.
8. Sayuti M.A. Formulasi dan Uji Stabilitas Fisik Sediaan Gel Ekstrak Daun Ketepeng Cina (*Cassia alata* L.), *Jurnal Kefarmasian Indonesia*, 2015; 5(2): 74–82.
9. Ali S.M., and Yosipovitch.G. Skin pH: From

Basic Science to Basic Skin Care, *Acta Derm. Venereol.* 2015; 93(3): 261–267

10. Hidayanti U.W., Fadraersada J., and Ibrahim A. Formulasi dan Optimasi Basis Gel Carbopol 940 dengan Berbagai Variasi Konsentrasi, *Proceeding Mulawarman Pharm. Conf.*, 2015; pp. 68–75.
11. Tonetti, M., Jepsen, S., Jin, L., Corgel, J. Impact of the global burden of periodontal diseases on health, nutrition and wellbeing of mankind: A call for global action. *Journal of Clinical Periodontology*, 2017; 44: 456-462.
12. Curtis, M.A. Periodontal microbiology: the lid's off the box again. *J. Dent. Res.,* 2014; 93: 840–842.
13. Sheskey, Cook,P.J., Cable,W.G., and Colin, G. *Handbook of Pharmaceutical Excipients 8th*, ed. Washington DC: Pharmaceutical Press. 2017.
14. Depkes RI. Farmakope Indonesia, Edisi IV. Departemen Kesehatan Republik Indonesia. Jakarta, 2020.
15. Numberi A.M., Dewipratiwi A., and Gunawan E. Uji Stabilitas Fisik Sediaan Masker Gel dari Ekstrak Alga Merah (*Poryphyra sp.*), *Maj. Farmasetika*, 2020; 5(1): 1–17.
16. Ratnasari dan Dessy, 2017. Optimasi konsentrasi basis PVA dan NaCMC pada penggunaan gel peel of lendir bekicot(Achatina fulivca) menggunakan aplikasi faktorial desain
17. Suartiningsih A., 2011. Formulasi sediaan gel lendir bekicot (Achatina fulica) dengan Natrium Carcoxymethyl Cellulose sebagai gelling agent untuk penyembuhan luka pada kelinci jantan, Skripsi, Universitas Muhamadyah Surakarta, Indonesi,