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ORIGINAL ARTICLE

Formulation and evaluation of red ginger extract tablet (*Zingiber officinale* var. *rubrum)* as lozenges

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Abstract

Red ginger (*Zingiber officinale* var. *rubrum*) with a high content of phenols (e.g. gingerol, shogaol, etc.) has potential effects against throat inflammation such as cold, sore throat, tonsilitis, etc. This research aims to determine the formulation of lozenge tablets using red ginger extracts. Lozenges tablets are made from dry ginger extract using a wet granulation method prepared by various concentrations of pregelatinized cassava starch 1 % w/v (F0); 2 % w/v (F1) and 5 % w/v (F2) as a binder and HPMC 2 % w/v (F3) as a comparative binder. Red ginger extract was prepared by maceration method using 96% ethanol solvent which is then evaporated using a rotary evaporator to obtain a thick extract. Thick red ginger extract is formulated into lozenges with various formulations F0, F1, F2, and F3. Physical characteristics evaluation of lozenge tablets includes physical appearance, weight uniformity, hardness, and disintegration time. The physical appearance of the tablet is round in shape and bright yellow in color. Based on the evaluation of all the formulas made, F2 has good criteria as a red ginger extract lozenge which has a hardness of 6 kg and disintegration time of 5 minutes 4 seconds.

Keywords: red ginger, *Zingiber officinale* var. *rubrum*, wet granulation, cassava starch

Introduction

Red ginger (*Zingiber officinale* var. *rubrum*) is a medicinal plant that grows in Indonesia, both planted as a side crop and planted in special areas. Red ginger with a high oleoresin (gingerol, shogaol) content has beneficial uses including as a body-warming drink, throat lozenge, anti-nausea, and other benefits.[1] Initially, red ginger was used as medicine in the form of herbal medicine and was drunk by brewing it in hot water.[2] This is less practical to use, so it needs to be prepared in the form of lozenges. Lozenges are easy to use which is when the lozenge tablets come into direct contact with the saliva and it will burst responsively.[3] The lozenges will disintegrate slowly in the mouth so that they are in contact with the taste stimulus for longer, therefore in the lozenge formula, the additional ingredients are added to cover up the unpleasant taste of the medicinal ingredients.[4]

There are still very few commercial red ginger lozenge tablets on the market, mostly in capsule and syrup preparations. Compared with other oral dosage forms, tablets actually provide advantages in the form of the smallest space/space required for storage, and tablets are also easy to administer and controlled, easy to carry, and low transport.[5]

Lozenges are generally used for the treatment of local irritation, and mouth or throat infections, but can also contain active ingredients that are indicated for systemic absorption after consumption.[6] The difference between lozenges and conventional tablets lies in the organoleptic properties, non-disintegration properties, and the extended dissolution rate on the tongue. Lozenges should not disintegrate while they are in the mouth.[7] The organoleptic properties and physical properties of lozenges

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are determined by the formula and conditions when the lozenges are molded. Therefore, good quality lozenges can be produced with suitable materials and proper manufacturing process conditions.[8]

Based on previous research[9] regarding the manufacture of dry extract lozenges of green betel leaves (*Piper betle* L) as a cough medicine, researchers are interested in producing a lozenge formulation from the red ginger extract which functions as a throat lozenge. The lozenges are formulated with several variations of pregelatinized cassava starch (PCS) as a binder.

Method

Preparation of Pregelatinized Cassava Starch (PCS)

Cassava starch is dissolved in a certain amount of water above the gelatinization temperature (70°C), until a clear paste is obtained. Then dry it using an oven at a temperature of 80°C ± 5°C. The flakes obtained are ground with a mortar and sifted then.[10]

Preparation of red ginger simplicia

Fresh red ginger is washed then wet sorted and drained. Red ginger is chopped to a thickness of 1-3 mm, then dried in the oven at a temperature of 40 °C. Dried simplicia is blended until homogeneous size, then sifted and weighed.[11]

Preparation of red ginger extract

The maceration process is carried out with 10 parts of solvent: 1 part of simplicia, for example, 1 kg of material in 10 L of ethanol. 200 grams of red ginger simplicia were extracted using the maceration method with ethanol 96% until the simplicia was completely submerged for 7 days, shaken and stirred occasionally, and filtered. Next, ethanol evaporation was carried out using a rotary evaporator and the result was a thick ethanol extract of red ginger.[11]

Phytochemical screening

In this study, the phytochemical screening carried out was the steroid/triterpenoid test, alkaloid test, flavonoid test, saponin test, and tannin test.[12]

Preparation of red ginger extract lozenges

The thick red ginger extract obtained is diluted by adding Amylum Manihot with a ratio of thick red ginger extract and Amylum Manihot 1 : 3, then crushed until homogeneous until a powder preparation is obtained, sifted, and dried. The red ginger extract was weighed 20 mg with the following formulation variations. Lozenges are prepared using the wet granulation method.[13]

Table 1. Red ginger lozenge tablets formulation

Materials (% b/v)	Formula			
	F0	F1	F2	F3
Red ginger extract	-	20	20	20
Sucrose	35.625	35.125	33.625	35.125
Lactose Monohydrate	35.625	35.125	33.625	35.125
PCS	1	2	5	-
HPMC	-	-	-	2
Talc	5	5	5	5
Citric Acid Anhydrous	2.5	2.5	2.5	2.5
Aspartame	0.25	0.25	0.25	0.25

Lozenge tablets physical appearance

Evaluation is carried out to see the general appearance of the tablet and parameters such as shape, color, and surface shape, as well as to detect any physical defects.[14]

Table 2. Weight uniformity requirements

Average weight	Weight difference (%)	
	A	B
25 mg or less	15	30
26 - 150 mg	10	20
151 - 300 mg	7.5	15
More than 300 mg	5	10

Weight uniformity

A total of 20 tablets from each formula were weighed and the average weight was calculated. Then weigh them one by one. The requirement for weight uniformity is that no more than 2 tablets deviate more than column A and none deviate more than column B.[14]

Hardness

The hardness testing tool used is the Erweka Hardness Tester. Generally, tablet hardness ranges from 4 - 10 kP (depending on the diameter and size of the tablet being made). The method is to place one tablet perpendicular to the tool, and then see at what pressure the tablet breaks.[15]

Disintegration time

Disintegration time was evaluated using a disintegrator tester. The tool consists of a series of baskets, a 100 ml thermostat beaker with a temperature of 36 – 38 °C, and a tool for raising and lowering the basket with a frequency of 29 - 32 times per minute. One tablet is put into each tube from the basket, one disc is inserted into each tube and run, as a medium used distilled water with a temperature of 37 ± 2 °C. At the end of the time limit, it is expressed as the disintegration time of the tablet, namely the time when all parts of the tablet have passed through the wire mesh. Testing with 6 tablets, where within 15 minutes all the tablets were crushed and passed through the gauze on the tube.[16]

Hedonic test

The lozenge formula was tried by 5 respondents, then the respondents gave their opinions on the appearance, taste, and aroma of the formula based on their tastes in the questionnaire provided.[17]

Results

Pregelatinized Cassava Starch (PCS)

Preparation of PCS begins by mixing the starch with distilled water and then dissolved at 80 °C. Next, the resulting thick mass was dried using an oven at a temperature of 80 °C. At this temperature the thick mass can be dried into white flakes, then the flakes are crushed using a mortar and then sifted.

Figure 1. Pregelatinized Cassava Starch

Red ginger simplicia

Fresh red ginger is washed then wet sorted, drained, and weighed. Red ginger is chopped to a thickness of 1-3 mm and then dried in the oven at a temperature of ±40 °C. Dried red ginger is characterized by being brittle when broken. Simplicia is powdered with a blender, and stored in a plastic container with a lid.

Figure 2. Red ginger simplicia

Red ginger extract

The results of extracting 1000 g of red ginger simplicia powder by maceration using 96% ethanol solvent with a ratio of powder to solvent of 1: 10, obtained a liquid extract which was then evaporated using a rotary evaporator, obtaining a thick extract of 300 g. This extract is used as an ingredient in the formulation of lozenges.

Figure 3. Red ginger extract

Phytochemical screening

Phytochemical screening tests were carried out to determine the chemical compounds contained in red ginger extract. Based on research conducted, the red ginger extract contains flavonoids, tannins, saponin, and steroid/triterpenoid compounds.

Weight uniformity evaluation

The results of the evaluation of the uniformity of lozenge weight (see Table 3) with a variety of binders with various concentrations of the four formulas, F0, F1,
F2, F3, fulfill the requirement that not a single tablet whose weight deviates from the specified requirements, according to the Indonesian Pharmacopoeia Edition III[18], namely not more than two

Table 3. Average weight of lozenges

Formula	Average weight
F0	17.5
F1	18.1
F2	17.6
F3	17.2

Table 4. Hardness results

Formula	Evaluation Hardness (Kg)	Requirements
F0	4.66	4 - 8 Kg
F1	6	
F2	6	
F3	5.33	

Table 5. Disintegration time evaluation results

Formula	Evaluation Disintegration (minute)	Requirements
F0	2.27	≤ 15 minutes
F1	3.30	
F2	5.4	
F3	2	

Table 6. Hedonic test results

Criteria	Respondent Number		
	Appearance	Taste	Aroma
Like extremely	1	-	-
Like	4	5	5
Dislike	-	-	-
Dislike extremely	-	-	-

tablets whose weights each deviate from the average weight of the price set in column A and not one tablet that deviates from the weight set in column B according to Table 2.

Hardness Evaluation

Based on Table 4 it can be seen that the tablet hardness of each formula is by the requirements set for tablet hardness, namely 4 - 8 kg, the tablet hardness of each formula varies according to the type and amount of binder used. Formula F1 - F2 has higher hardness compared to formula F0 - F4. Formula 2 using PCS binder produces greater hardness compared to all formulas with a hardness of 6 kg.

Disintegration time

The results of the four formulas show that all formulas meet the disintegration time requirements. The disintegration time of each formula varies according to the type and amount of binder used (see Table 5).

Hedonic test

The taste sensation is one of the most important sensory qualities of food, including sour, sweet, bitter, salty, umami, and some other taste.[19] To complete this research, a preference test was carried out on respondents by distributing questionnaires. On this occasion, only formula 2 was tested on respondents because this formula was the best formula among the other formulas. A total of 5 respondents have given their opinions regarding the appearance, taste, and aroma.

Discussion

The aim of this research is to produce a lozenge formulation from the red ginger extract which has functioned as a throat lozenge. The preparation of red ginger is conducted by washing, wet sorting, draining, chopping, and then drying in the oven at a temperature of 40°C. The drying aims to decrease the moisture content of red ginger and chopping aims to make the surface area larger, thus increasing the effectiveness of the interaction between solvents and dissolved compounds. The compounds that were identified with phytochemical screening were alkaloids, flavonoids, tannins, saponins, and steroid/triterpenoid compounds Based on the phytochemical screening result, the red ginger extract contains flavonoids, tannins, saponins, and steroid/triterpenoid compounds. Alkaloids are reported to have analgesic, anti-inflammatory, and adaptogenic activities, flavonoids have several biological activities with health benefits such as antiatherosclerosis, and cardiovascular protection, and saponins and tannins have anti-inflammatory effects.[12] The extraction of red ginger was performed with the maceration method using 96% ethanol as a solvent with a ratio of powder to solvent of 1: 10.

From the result of the phytochemical screening, the red ginger extract contains flavonoids, tannins, saponins, and steroid/triterpenoids. The screening results of the red ginger extract showed the presence of saponins with the formation of stable foam, flavonoids were shown with an intense red color, tannins gave the result a greenish-black color, steroids were shown with a green color, and triterpenoids were indicated by the formation of brownish-ring.[12]

The physical appearance of the F0, F1, F2, and F3 tablets is round, and the color of the F0 lozenges is white, while F1, F2, and F3 are bright yellow, because they use ginger extract while F0 do not use ginger extract. The red ginger extract lozenges are prepared using the wet granulation method to obtain a good flow rate and compressibility so that tablets that meet the requirements will be produced.[20] All formulas

use a combination of sucrose and lactose monohydrate as fillers and sweeteners. Pregelatinized cassava starch (PCS) is used as a binder by mixing it with distilled water until a paste forms. PCS is used in formulas F0, F1, and F2 in various concentrations, while in formula F3 HPMC is used as a comparison. As a lubricant, talc is used with a concentration of 5%, the talc concentration used is high enough to overcome sticking. Meanwhile, to improve the taste of the lozenges, aspartame is used as a sweetener, and citric acid is used to provide a sour taste sensation. The PCS concentration was varied at 1%, 2%, and 5%, while the HPMC concentration was 2%. The comparison of PCS concentrations in the three formulas aims to determine the influence of PCS concentrations on the dissolution time of the lozenges. The lozenge mass is sifted to make it easy to dry, the lozenge mass is then dried to remove the solvent used in the granulation process and to reduce moisture. The drying process was carried out for five hours at 40°C so that the humidity was small enough to avoid sticking.

The red ginger lozenges were obtained by wet granulation method with a variation of binder concentration. The PCS binder resulted in tablets that had better strength in relation to disintegration. Preparation of PCS as binder begins by dissolving the starch with distilled water. In this process, the starch will expand properly.[21] This process is carried out to damage the starch molecules and the presence of water causes gelatinization to occur. The water molecules will enter the starch molecules so that the starch expands and a thick mass will form. In the presence of water, the concentration of starch is related to the formation of a barrier. The higher the starch concentration, the thicker the barrier formed. As the thicker barrier formed causing higher disintegration inhibition.[22]

Based on the results of physical evaluation tests of red ginger lozenges, which include weight uniformity, hardness, and disintegration time, overall meet all the specific requirements. A lozenge tablet is declared destroyed if it dissolves in a test medium or disintegrates into many particles. The first important step before dissolving is breaking the tablet into small particles or granules which is called disintegration.[23] Tablets containing a higher degree of hydroxypropyl substitution show longer disintegration time, in this case, the higher PCS concentration.[24]

Based on the results of the respondents' hedonic test, four respondents liked the appearance of the lozenges, one respondent liked it extremely, and not a single respondent disliked the appearance of the lozenges. Meanwhile, for the lozenge taste, all respondents said they liked it. This is due to the combination of the sweet and sour taste of sucrose and citric acid, then the spicy taste of red ginger extract is added, giving it a sour, spicy, and sweet taste. As for the aroma, all respondents liked it. The present review will mainly focus on texture – taste – aroma interactions. Once the food has been transferred to the mouth, the different processes that occur during mastication alter the physical properties of the food and affect the perception of texture and flavors (aroma and taste). Reciprocally, taste and aroma perceptions may affect the perception of the food texture.[17]

Conclusion

Red ginger extract was prepared by various types and concentrations of binders can be made into lozenge tablets using the wet granulation method. The evaluation results of red ginger extract lozenge tablets produce disintegration time, weight uniformity, and hardness by the tablet evaluation requirements. The optimum quality is produced from F2 red ginger lozenges using PCS binder which has good criteria with a hardness of 6 kg and disintegration time of 5 minutes 4 seconds.

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