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Functional Drinks from a Rhizome of Nut Grass (*Cyperus rotundus L.*) with Mixed Fruits

Mazarina Devi[1*], Soenar Soekopitojo[2], Desiana Merawati[3]

[1,2]*Prodi Pendidikan Tata Boga, Fakultas Teknik, Universitas Negeri Malang*
[3]*Prodi Ilmu Keolahragaan, Fakultas Ilmu Keolahragaan, Universitas Negeri Malang*
Jalan Semarang 5, Malang 65145, Indonesia
**corresponding autor, email: mazarina.devi.ft@um.ac.id*

ABSTRACT
This research aims to get the technology of production process of the functional beverage of teki extract to obtain the formula of the functional beverage made of teki grass rhizome extract preferred by girls teenagers to cure the dysmenorrhoea problem. Such functional beverage is made of the extract of teki grass rhizome and the extract of any fruits such as pineapple, strawberry, and soursop added sugar and water. The production of teki extract is through the stages of sorting, washing, blanching, demolition, blending, heating and filtering. The chemical quality (Ca, Mg and Femineral) and the organoleptic characteristics (hedonic and hedonic quality) of teki extract were analyzed, and the experimentalmouse was pre-clinical tested to know its effect on the heart function by using SGPT and SGOT analysis. The research results show that the formula of teki extract with the rhizome of teki grass and the extract of pineapple (b/b) is recommended based on the hedonic characteristics andhedonic quality of taste, smell and the mineral contain such as Ca (2.27 ppm), Mg (46,94 ppm) and Fe (1,09 ppm).The teki extract has sweet-sour taste and theratherstrongdistinctive smell of teki. Teki extract did not cause heart function disorder of the experiment mouse with the content of SGOT was 109 U/L (the control one was157 U/L) and SGPT was 56,6 U/L (the control one was68,5 U/L).
Keywords: *Cyperus rotundus, the extract of teki, functional beverage, fruits*

I. INTRODUCTION

Teki grass (*Cyperus rotundus* L.) is a kind of grass growing wildly, and it is easy to find. This particular plant is included in Cyperaceae family more acknowledged as a "World's Worst Weed" or destruction plant (Mohamed, 2015). As a herb plant, teki grass can potentially be used as traditional medicine ingredient, and it does not give side effect for the health so it is safe to consume. Teki grass as an alternative to serve as antibacterial used to traditional medicine (Yagi et al., 2016). In the Arabic country, teki grass is consumed by toasting it for health food as the seasoning of curry and pickle (Hemanth Kumar et al., 2014). The rhizome of teki grass is used in India as a medicine to reduce diarrhea, indigestion, and fever. In China, the rhizome of teki grass is used to cure the problems of stomach and woman's hormone (Sayed et al., 2007). The phytochemical and pharmacological activities of *C. rotundus* have supported its traditional as well as prospective uses as a valuable Ayurvedic plant. Indonesian society in the area of Kulon Progo and Jemur Sari Surabaya use boiling herbal medicine of the rhizome of teki grass to reduce and cure the sprue pain. The use of teki grass as a functional food gives an economical value of the rhizome of teki grass.

The functional food consumed like the ordinaryfood and drink has sensory characteristics such as appearance, color, texture, and taste accepted by the consumers and it does not give the side effects of the metabolism of the other nutrition if it is used in the suggested amount (Peerzada et al., 2015). The is a functional food product that is natural or has been processed containing one or more compound/s claimed to have particular beneficial physiology function to the health based on the scientific studies ("Position of the American Dietetic Association," 2004).

The development of functional beverage influences the human's age period as well (Bhuiyan et al., 2012). The functional beverage with natural compositions is relatively acceptable, and it is beneficial for the body's health (Adegunloye, 2015). (Oliveira et al., 2013). State that the trusted product having an advantage for the human's body is a herbal beverage. This reason causes the development of functional beverage having three essential functions inside the human's body such as having high nutrition (nutritional aspect), beautiful and delicious taste (visual aspect) and giving benefits for the body's health (physiological aspect) (Belewu and Abodunrin, 2008).

The development of beverage formulation is necessary for food manufacturing industry so the functional beverage which is acceptable to the society from the aspect of

sensory can be producedin bulk. The mixing of spices in a beverage formulation is to get a combination which is more beneficial for the health rather than they are used separately (Caputo et al., 2004).

Based on such case, the functional beverage of teki grass rhizome mixed with pineapple, soursop, and strawberry should be developed to cure the menstrual pain (dysmenorrhea) of the girl teenagers. The smell and taste of fruits are expected to disguise the weakness of the teki grass rhizome from the aspect of sensory so that this particular beverage can be accepted among the society. Besides, the extract of the fruits adds the health benefit of the rhizome of teki grass.

The development of the functional beverage of teki extract aims to get the technology of the production process of the functional beverage of teki extract preferred by the girl teenagers to cure dysmenorrhea problem. The chemical quality (mineral Ca, Mg and Fe) and the organoleptic characteristics (hedonic and hedonic quality) of teki extract were analyzed, and the experimental mouse was pre-clinical tested to know its effect on the heart function of the mouse by using SGPT and SGOT analysis.

II. COMPOSITION AND METHOD

This research is an experimental study with a Complete Random Design. This particular design is an environmental design by positioning the treatments to all experiments by scrambling completely

Time and Place of Research

The test of hedonic quality and hedonic were conducted in the Laboratory of Food Industry, Department of Industry Technology, Faculty of Engineering, State University of Malang on April 2016. The chemical test was conducted in the laboratory of Faculty of Agriculture Technology, State University of Brawijaya Malang.

Composition

The composition used to produce the extract of teki was the rhizome of teki grass (the minimum length is 2 cm) found in the area of Malang, pineapple, soursop, strawberry, sugar, and water. The compositions for mineral (Ca, Mg, Fe) analysis with the method of AAS (Atomic Absorption Spectrophotometer) such as standard solution (Ca, Mg, Fe), free ion-water, strain paper of Whatman No. 541.

Functional Beverage Formulation of Teki Extract

The first step of this research was formulating the functional beverage of tekiextract with fruit flavor (pineapple, strawberry, and soursop). Globally, the tekiextract is made through the steps of sorting, washing, blanching, demolition, blending, heating and filtering. Subsequently, the second stage was analyzing the material contain (Ca, Mg, and Fe) of teki extract as the formulation result of teki extractin the first step and its organoleptic characteristic. The analysis results become the standard to determine the extract of teki recommended to produce.

Analysis of Mineral (Ca, Mg and Fe).

The analysis of mineral (Ca, Mg, and Fe) contained in the extract of teki was by using Atomic Absorption Spectrophotometer (AAS) referring to AOAC method FM-841. The standard of Ca, Mg and Fe was made by the concentration of 0.5ppm, 1ppm, 2ppm, 4ppm, 8ppm, and 16 ppm. The standard curve was made then as well. The sample of the 25 ml of teki extract was put into AAS pumpkin. Meanwhile, AAS tool was prepared by setting the hollow cathode lamp, air rate and the fuel connected to the computer to note the analysis results. After that, the analysis of each sample was conducted by using AAS tool.

Organoleptic Test

Organoleptic test conducted was the test on the taste and smell favorite. The instrument employed in this research was an assessment sheet containing the research format of hedonic and hedonic quality tests. Filling the sheet was by giving checklist (√) on the right answer based on the panelist. The technique used was scoring having score range of 1-5. The lowest score was 1, and the highest one was 5.

The hedonic test was with 1 scale (dislike) until 5 (like). The hedonic testwas conducted to the influence of the ratio of tekigrass rhizome and teki extract smell. The panelist involved in this research were 25 girl students of State University of Malang who were 18-20 years old with three times of repetition.

The data of the research result from the three times of repetition was analyzed statistically by using ANOVA (Analysis of Variance) to know the influence of the treatment effect.Subsequently, the difference significance ($p<0.05$) among the samples was analyzed by using DMRT (Duncan's Multiple Range Test) assisted by SPSS 17.0 software.

SGOT and SGPT Analysis on the Experimental Animal

A female white mouse of Wistar type (125-175 g) was employed to evaluate the heart function after it was giventhe functional beverage of teki extract. There were five samples for every teki extract formulation. The experimental animal adapted for two weeks to the 512 standard ration food and standard drink water. Giving teki extract was conducted for seven days based on the treatment group. In the seventh day, the 5 ml of blood of the mouse was taken to be treated by biochemistry test: SGPT (Serum Glutamic Pyruvic Transaminase) and SGOT(Serum Glutamic Oxaloacetic Transaminase).The serum enzymatic parameter like SGPT and SGOT was tested based on the standard method (Gupta et al. 2013).

III. RESULTS AND DISCUSSION

Formulation of Functional Beverage of Teki Extract

The process of making abeverage ofteki grass rhizome extract with the flavor of pineapple, strawberry, and soursop refers to SNI 01-3719-1995about the fruit extract modified by the researcher (Figure 1).

The rhizome of teki grass sorted has the diameter size about 0,5 cm, and the length size was 1-2 cm. The rhizome was washed to clean the ash that still sticked to the peel. It was then peeled off and weighed. The weighing was done after the washing step in order the net of the rhizome did not blend the ash and the peel of the rhizome. The clean rhizome of teki grass was blanched in the boiling water with the temperature of 85ºC for three minutes to reduce the unpleasant taste. The blanching rhizome was blended with strawberry/pineapple/soursop and 250 ml of water by using ablender. After that, 40 g of sugar was added into the blended rhizome and fruits, and it was boiled at the temperature of 60ºC for 30 minutes to reach TPT 20 ºBrix. The beverage of tekigrass extract was added with 0,20 g of acid citrate for strawberry flavor, 0,30 g for the taste of pineapple or soursop. The different composition of acid citrate aims at reaching pH 4,0. The beverage of teki grass rhizome with strawberry, pineapple and soursop flavors was packaged in a plastic cup and pasteurized at the temperature of 77ºC for one minut.

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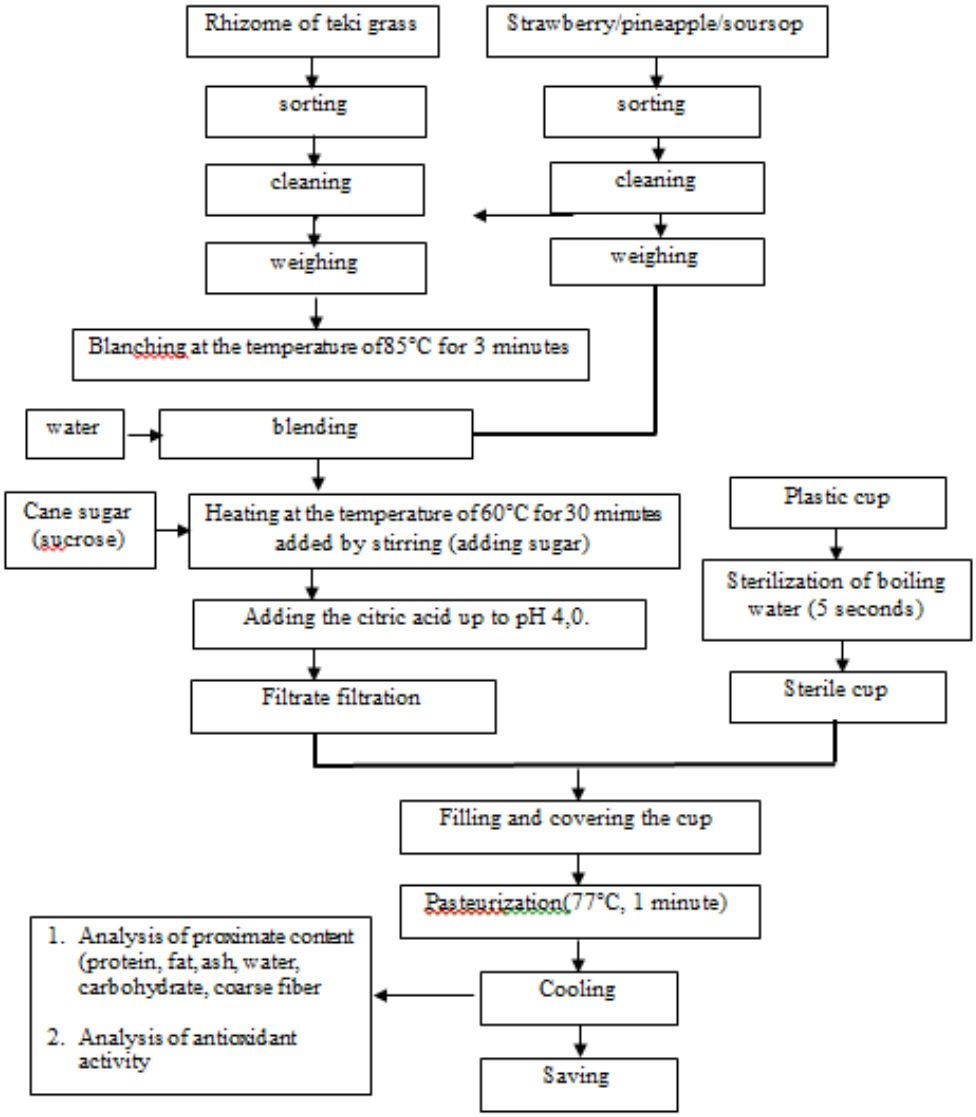

Figure 1.The Flow Diagram of Making Beverage of Fruit Flavored-Teki Grass Rhizome

Analysis of Mineral Content of Teki Extract

Mineral content (Ca, Mg and Fe) of teki extract can be seen in Table 1. The mineral content of teki extract is originated not only from teki grass rhizome but also from fruits and sugar containing a group of mineral as well. The mineral (Ca, Mg and Fe) content of teki extract is relatively so lower than the fresh material since in the making process of teki extract, the process of dilution by using water up to 40 times occurred.

The content of Ca of teki extract was approximately 1,59 ppm to3,00 ppm. The statistical analysis results show that the type of fruit extract used did not significantly influence ($p=0.21>0.05$) the Ca content of teki extract.

Table 1. The Average of Mineral (Ca, Mg and Fe) Content of Teki Extract

Formulation	Mineral Content (ppm)		
	Ca	Mg	Fe
Strawberry	(3,00)	(82,1)	(0.81)
Pineapple	(2.27)	(46,94)	(1.09)
Soursop	(1,59)	(90,26)	(0.81)

The content of Mg of teki extract was about 46,94 ppm to 90,26 ppm. The statistical analysis results show that the ratio of teki grass rhizome and fruits significantly influenced ($p=0.01<0.05$) the Mg content of teki extract. The result of DMRT indicates that there is a different Mg content of teki extract in each ratio of teki grass rhizome and fruits.

The Mg content of teki grass is relatively so higher than that of fresh fruits which are 560 ppm and 43 ppm (Bermawie and Purwiyanti, 2010); while the Mg content of sugar 290 ppm (Bank, 2000). The change of the number of teki grass rhizome in the teki extract formulation is reflected in the Mg content of teki extract.

The Fe content was approximately 0.81 ppm to 1,09 ppm. The statistical analysis results show that the ratio of teki grass rhizome and fruits significantly influenced ($p=0.02<0.05$) the Fe content of teki extract. The result of DMRT shows that the Fe content of teki extract with the ratio of teki grass rhizome and fruits is not different while with the other formulation it is different. The Fe content of teki grass rhizome is 32 ppm while the Fe content of fresh fruits is 16 ppm and sugar contains 26 ppm of Fe. The Fe content of teki grass rhizome and fruits is not so far different. The formulation changing in teki extract definitely influences the Fe content of teki extract although statistically there is a formulation which is not different.

Chocano-Bedoya et al., (2011) state that the sufficient intake of non heme Fe can reduce the risk of painfultowards the menstruation period after the intake of Ca and other factors is adjusted. The non heme Fe is much found in the plants and supplement while the heme Fe is much found in the animals. Meanwhile, the intake of K will increase the dysmenorrhoea risk while the intake of Ca, Mg and Zn is not related to dysmenorrhoea risk and also the ratio of Ca and Mg. Besides, Atallahi et al. (2014) say that the diet of wheat extract (containing Mg, Zn, Ca, vitamin E, vitamin C, vitamin B12, vitamin B6, thiamin, riboflavin, niacin, folate acid and iron) can reduce the systemic symptom related to dysmenorrhoea like fatigue, headache, and anxious.

Teki extract still has many minerals associated with the dysmenorrhoea symptom although in a relatively little amount as the result of dilution process. Based on such fact, teki extract is still recommended to be a functional beverage based on the benefits of its bioactive components (Emelugo et al., 2011). In addition, the mineral fortification of the functional beverage of teki extract can be a further alternative in developing the functional beverage of teki extract.

The Organoleptic Test of the Functional Beverage of the Extract of Teki

A hedonic test used in this research including the hedonic test of flavor and smell. Both tests aim at knowing the teki extract taste and smell favorite level of thepanelist. The hedonic test results are presented in Figure 2.

The level of the panelist's favorite taste of fruit flavored-teki extract is categorized as amoderate. The ANOVA analysis results show the exact difference of the use of fruits to the result taste hedonic test of teki grass rhizome beverage. From the research results, it is found that pineapple flavor is more preferred rather than strawberry and soursop flavors. The pineapple flavor is exactly different from the strawberry and soursop flavors. This finding is because pineapple can cover the bitter taste of teki grass rhizome. The additional of soursop flavor is not so far different from that of strawberry. It means that the additional of soursop flavor can give good enough taste according to the panelist, but it cannot give the preferred taste.

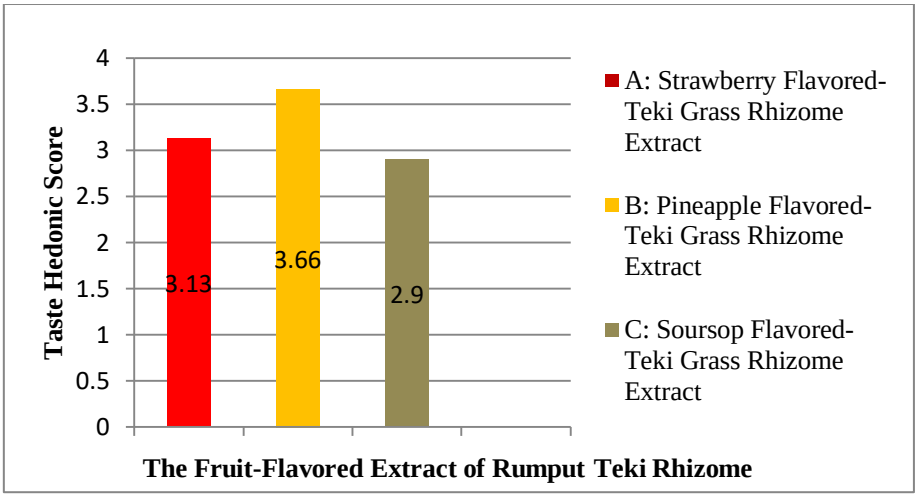

Figure 2. The Score of Panelist's Favorite Taste of the Fruit-Flavored Extract ofTeki Grass Rhizome

The factors influencing the beverage flavor is organic compound composition contained in the used material, the type and content of pure sugar used and the making process of the beverage conducted (Hui, et al., 2010). The organic compound composition influences the characteristics of fruit flavor. The flavor of teki grass rhizome beverage is originated from the raw material of teki grass rhizome and the added fruits as the additional flavor. The compounds of teki grass rhizome and they are assumed can affect the taste such as alkaloid, cineole, cyperone, camphene, cobusone, limonene, rotundone, glucose, fructose, and sucrose (Xu et al., 2008). In strawberry, the compounds claimed giving flavor effect are glucose, fructose, sucrose, gallic acid, catekin, anthocyanin, malic acid, citrate acid, coumaric acid, pectin, and quercetin. In soursop, the compounds that can give the flavor effect such as glucose, fructose, sucrose, annonacin, ascorbic acid, citrateacid, and muricine. In pineapple, the compounds assumed giving the flavor effect are glucose, fructose, sucrose, citrate acid, acetate acid, ananasic acid, ascorbic acid, bromelain, malic acid, chavicol and terpineol (Carbonaro et al., 2002). Ananasic acid, bromelin, chavicol and terpineol that are available only in pineapple are more influential to cover the bitter taste of teki grass rhizome extract.

The smell of teki grass rhizome extract is originated from teki grass and fruits as the flavor additional used (Figure 3). The distinct smell of teki is originated from the essential oil which is a volatile component giving the peculiar smell of teki (Mohamed, 2015). Such compound are for example cineole, cyperene, cyperenone, cyperol, cyprerotundone, limonene (Zhou and Yin, 2012). This research used the other materials which are strawberry, pineapple, and soursop that can fix the taste and smell. Smell is much more influenced by an aromatic compound of the used materials. There are around 350 compounds in strawberry. Such compounds are for example furaneol, methyl and ethylbutanoat, buthylacetate, methyl and ethyl hexanoate, linalool, decalactone, butanediol, hexanal, hexenal (El Hadi et al., 2013). There are more than 280 aromatic compounds in the pineapple. Esther and hydrocarbon are the main compounds. Octanoic acid, methyl ester, hexanoic acid, octanoic acid and ethyl esterare the specific aromatic compounds of pineapple (El Hadi et al., 2013). The compounds of some varieties as a particular smell compound are furaneol, propanoic acid ethyl ester, ethyl 2methylbutyrate, ethyl butanoate, ethyl hexanoate, methyl butanoate (Hemanth Kumar et al., 2014) (El Hadi et al., 2013). In soursop, there are ethyl acetate, methyl butanoate, hexanal, isoamyl acetate, hexenal, methyl hexanoate, ethyl hexanoate, methyl octanoate, trans b ocimene, terpinolene, hexyl acetate, hexenal, hexanol, hexanol, linalool, caryophyllene, butanoic acid, hexanoic acid (Rahardjo and Eddy Santoso, 2016)

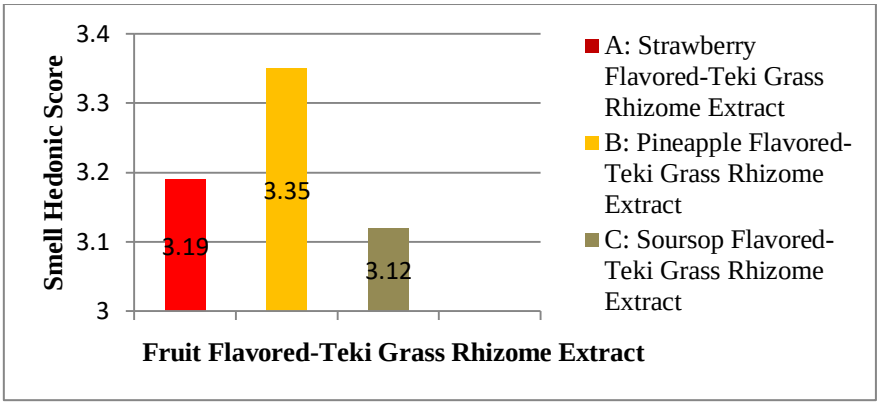

Figure 3. Score of Panelist's Favorite of the Fruit Flavored-Teki Grass Rhizome Smell

The impression of smell and taste is hard to separate since they influence each other. Like the taste, the smell of teki extract is much influenced by the essential oil in the teki grass rhizome like α-cyperone, myrtenol, caryophyllene oxide, α-pinene, β-pinene, α-selinene (Lawal and Oyedeji, 2009) or the essential oil of fruits such as zingiberene, curcumin, philandren andoleoresin gingerolsdan shogaols (Bhattarai et al., 2001).

SGPT and SGOT Analysis on the Experimental Animal

The products usually measured as the parts of heart function test are ALT (Alanine Aminotransferase) or SGPT (Serum Glutamic Pyruvic Transaminase), AST (Aspartate Amino transferase) or SGOT (Serum Glutamic Oxaloacetic Transaminase), ALP (Alkaline Fosfatase), gamma-GT (Glutamyl Transferase), bilirubin and albumin (F.O. Ahamefule. et al., 2006). In this research, the SGPT and SGOT content analysis in the blood serum of the experimental animal (mouse) was after it was given the functional beverage of teki extract for seven days.

The analysis result shows that the SGPT content of the experimental animal was approximately 47,2 to 119 U/L (the control one was 68,5 U/L) and the SGOT was about 107to119 U/L (the control one was157 U/L).These cases show that teki extract did not cause heart function disorder to the experimental mouse since the contents of SGPT and SGOT of the experimental mouse were not different from the control ones and since the analysis was not specific.The hepatic cell has a role in the metabolism activity and contains enzyme. SGPT and SGOT are the mitochondriaenzyme. If the heart suffered damage, the transportation function from hepatocyte is disturbed, and it causes the leakage of theplasma membrane and the increase of enzyme in the serum. The growth of enzyme activity indicates the damage of cell and all functions of the cell membrane in the heart (Gupta et al., 2013).

IV. CONCLUSION

The research result show that the formulation of teki extract with the ratio of teki grass rhizome and fruits is 70:30 (b/b) is recommended to produce based on the hedonic and hedonic quality characteristics of the taste and smell as well as the mineral contents which are Ca (2.39 ppm), Mg (0.87 ppm) and Fe (0.06 ppm). The extract of teki has a somewhat bitter sweet taste with the rather strong and strong smell of teki. The extract of teki did not cause heart function disorder to the experimental mouse with the content of SGOT was 109 U/L (the control one was157U/L), and the content of SGPT was 56,6 U/L (the control one was 68,5 U/L).

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