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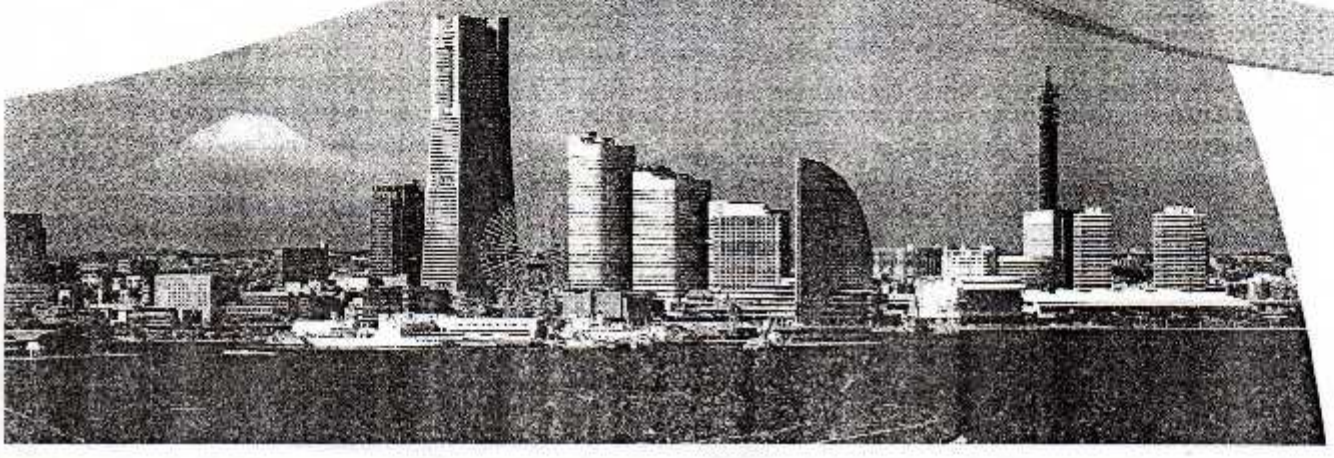

PS-02-p-121

Environmental chemical-like action of kavalactones used in anxiolytic herbal supplements

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Objectives: Kava (*Piper methysticum*) is an herbal material probably associated with severe liver injury despite its promising anxiolytic activity. In our previous report, like hepatotoxic environmental chemicals, kava products markedly enhanced cytochrome P450 1A1 (CYP1A1) mRNA expression with liver enlargement in rats (Yamazaki *et al.*: 2008). The purpose of this study is to examine the environmental chemical-like action of kavalactones, major ingredients of kava, with special interest in their interaction with CYP1A1.
Materials & Methods. Effects of kavalactones (ChromaDex) on recombinant human CYP1A1 (Sigma) enzyme activity were examined by fluorometric rate assay using resorufin derivatives as substrate. Reaction products of CYP1A1 and kavalactones were analyzed by HPLC. Effects of kavalactones on CYP1A1 gene expression was investigated using human hepatoblastoma HepG2 cells. CYP1A1 gene expression at mRNA level was analyzed by real-time RT-PCR.
Results & Findings. Desmethoxyyangonin (DMY) and yangonin (Y) strongly and competitively inhibited ethoxyresorufin-O-deethylase activity of CYP1A1. HPLC analyses of the reaction product of CYP1A1 and DMY or Y suggested that both kavalactones were substrates of CYP1A1 and gave an identical product. When DMY alone was added to HepG2 cells, CYP1A1 mRNA expression slightly but significantly increased. In contrast, addition of benzo[a]pyrene (BP), a substrate of CYP1A1, strongly enhanced CYP1A1 expression at 4 h and this enhancement rapidly degraded thereafter. DMY was shown to maintain the BP-induced enhancement of CYP1A1 expression.
Conclusion: DMY, like BP, was recognized as substrate by CYP1A1 enzyme *per se*. DMY and BP enhanced CYP1A1 expression, although their action mechanisms were different. Overall evidence suggest that a part of kavalactones possesses environmental chemical-like actions.

keywords: herbal supplements, CYP1A, kavalactones

PS-02-p-122

Induction of heme oxygenase-1 with quercetin reduces obesity-induced hepatic inflammation through macrophage phenotype switching

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Objectives Our previous study has shown that quecetin, an abundant flavonoid in plants, ameliorates adipose inflammatory response by reduction of macrophage accumulation and cytokine release in obese mice. Heme oxygenase-1 (HO-1), which elicits antioxidant and anti-inflammatory activity, modulates macrophage phenotypes and thus is implicated in various inflammatory diseases. In this study, we investigated whether HO-1 contributes to the protective effects of quercetin on hepatic inflammatory cytokine levels and macrophage phenotype switching in obese mice.
Methods Male C57BL/6 mice were fed a regular diet (RD), high fat diet (HFD), or HFD supplemented with quercetin (HF+Que, 0.5g/kg diet) for 9 weeks. Inflammatory cytokines and macrophage marker were measured by ELISA and RT-PCR, respectively. HO-1 transcripts and proteins were measured by RT-PCR and western blotting.
Results Quercetin supplementation decreased levels of inflammatory cytokines (TNFa, IL-6, MCP-1) and increased level of anti-inflammatory cytokine (IL-10) in liver of the HFD-fed mice. Quercetin enhanced transcript levels of M2 macrophage marker gene (Arg-1, CD163), while reducing transcripts of M1 macrophage markers (TNFa, CD274) in the liver of the HFD-fed mice. Moreover, quercetin upregulates HO-1 expression in liver of the HFD-fed mice. In vitro results showed that quercetin markedly enhanced HO-1 expression at mRNA and protein levels in hepatocytes, and suppressed inflammatory cytokine release from lipid-laden hepatocytes and cocultured hepatocytes/macrophages and this effect was blocked by a HO-1 inhibitor.
Conclusion These findings indicate that induction of HO-1 with quercetin suppresses obesity-induced hepatic inflammation via macrophage phenotype switching. Quercetin may be a useful phytochemical to reduce obesity-induced hepatic inflammation.

keywords: Quercetin, Heme oxyganase-1, Hepatic inflammation

PS-02-p-123

Collagen from jellyfish stimulates mouse bone marrow-derived dendritic cells

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1. Objectives
Collagen extracted from jellyfish *Nemopilema nomurai* becomes a valuable marine organism for nutraceutics, cosmetics, and functional foods due to its versatile health benefits. Our previous studies have revealed that jellyfish collagen (JC) stimulates immunoglobulin and cytokine production by lymphocytes and macrophages *in vitro* and *in vivo*. To have a comprehensive understanding, we then focused on the immunostimulatory effect of JC on mouse bone marrow-derived dendritic cells (BMDCs).
2. Materials & Methods
Dendritic cells were induced by culturing mouse bone marrow cells in a 10% FBS-RPMI 1640 medium supplemented with 20 ng/mL of recombinant mouse granulocyte-macrophage colony stimulating factor (rmGM-CSF) for 8 days. A conventional light-microscope was used to observe morphological changes of BMDCs. Phagocytosis activity and MHC-II expression level on BMDCs were measured by a flow cytometer. IL-6 and IL-12 produced by BMDCs were assessed by ELISA. Real-time RT-PCR was used to determine mRNA expression level in BMDCs.
3. Results & Findings
JC-treated BMDCs have more and longer pseudopodia on the cell surface compared to those of control cells. Flow cytometry analysis showed that the $CD11c^{+}MHC\text{-}II^{hi}$ cells population increased from 10.8% in the control cells to 32.1% in the JC-treated cells. Greater zymosan uptake was observed in control cells (92.1%) compared with JC-treated cells (86.3%), indicating the transition process of BMDCs from antigen-capturing cells to antigen-presenting cells. Moreover, JC stimulated IL-6 and IL-12 production by facilitating mRNA expression levels in BMDCs.
4. Conclusion
JC has the potential to stimulate dendritic cells and thereby contributing to the health enhancement.

keywords: dendritic cells, immunostimulation, jellyfish collagen

PS-02-p-124

The Utilization of Mangosteen (Garcinia Mangostana Linn) Pericarp to Develop Instant Pudding for Cancer Patients

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This experimental study aimed to develop the utilization of mangosteen pericarp in production of instant pudding for cancer patients. This study consisted of five stages, namely mangosteen pericarp extraction, xanthone and nutrition analysis, pudding instant with mangosteen pericarp extract formulation, organoleptic test, xanthone and nutrition analysis of selected instant pudding. Used mangosteen pericarp is dried mangosteen pericarp comes from Kaligesing, Central Java. This variety is chosen because it has the characteristics of thick mangosteen skin and purplish red. The extraction is done by maceration using 96% ethanol. Mangosteen pericarp extract contained 20.72 mg α-mangostin/ g mangosteen pericarp extract, water contents 4.61%, ash contents 0.57%, protein contents 0.42%, fat contents 0.32% and carbohydrate contents 94.08%. Characteristics of mangosteen pericarp extract was pink, slighty sour flavour, sour taste slighty bitter typical of mangosteen pericarp. Pudding making process through the dry mixing stage, where all materials as well as the addition of mangosteen peel extract (F1 : 2.5%, F2 : 5% and F3: 7.5%), and the next stage is the addition of boiling water. The water temperature range is about 80° C, it is to avoid cause the damage on xanthones. Based on organoleptic test, F1 (2.5%) was the best formula. It contained 366 mg α-mangostin/ serving size of 230 g, energy 207 kkal, protein 2.58 g, fat 3.08 g, carbohydrate 42.32 g. Pudding mangosteen pericarp extract can be considered as a functional food with a high xanthones and good for cancer patients.

keywords: mangosteen pericarp extract, antioxidant, xanthone

Utilization of Mangosteen Pericarp Extract (Garcinia Mangostana Linn) in Development of Instant Pudding for Cancer Patients

Tiurma Sinaga, Reisi Nurdiani, Marisya Fitriyani,

ABSTRACT

The study aimed to develop the utilization of mangosteen pericarp in production of instant pudding for cancer patients. This study consisted of five stages, namely mangosteen pericarp extraction, xanthone and nutrition analysis, pudding instant with mangosteen pericarp extract formulation, organoleptic test, xanthone and nutrition analysis of selected instant pudding. The extraction is done by maceration using 96% ethanol. Mangosteen pericarp extract contained 20.72 mg α-mangostin/g mangosteen pericarp extract, water contents 4.61%, ash contents 0.57%, protein contents 0.42%, fat contents 0.32% and carbohydrate contents 94.08%. Characteristics of mangosteen pericarp extract was slighty red, slighty sour flavour, sour taste slighty bitter typical of mangosteen pericarp. Based on sensory evaluation test, F1 (2.5%) was the best formula. It contained 366 mg α-mangostin/serving size of 230 g, energy 207 kkal, protein 2.58 g, fat 3.08 g, carbohydrate 42.32 g. Pudding mangosteen pericarp extract can be considered as a functional food with a high xanthones and good for cancer patients.

Keywords: antioxidant, mangosteen pericarp extract, pudding, xanthone

INTRODUCTION

According to the WHO (2013), cancer is the second leading cause of death in the world, after cardiovascular disease. One of the causes of cancer associated with environmental and lifestyle. All causes of cancer, one of which is due to environmental factors, and about 40-60% associated with nutritional factors (Mangan 2009).

Food is one of the important factors in the development of cancer, especially the content of antioxidants in foods that can inhibit the development of chronic and degenerative diseases (Pham-Huy et al. 2008). Cancer patients generally eat foods that contain lots of free radicals, such as processed foods by frying using degraded oil, as well as processed foods by burning. The lack of consumption of food sources of antioxidants also be a risk factor for cancer (Mangan 2009).

Meydani et al. (2013) stated that the increase in food consumption of antioxidants can improve immune response in adult person. Antioxidants are compounds that can reduce the risk of chronic diseases, such as cancer and

coronary heart disease (Amrun et al. 2007). Xanthones and their derivatives are one of antioxidant compounds that are highly effective in preventing the formation of cancer. Shan et al. (2011) mentions that the xanthones in mangosteen pericarp extract can control the phase of carcinogenesis, especially in the growth stage of cell division, apoptosis, inflammation, and cancer cell metastasis.

Mangosteen (Garcinia mangostana Linn) is one of the xanthone rich fruit. The mangosteen fruit is generally consumed flesh alone, and the pericarp of the fruit as much as ¾ of the fruit is discarded as trash. Mangosteen pericarp can be one source of xanthones. It provides opportunities for the development of mangosteen pericarp as a functional food mainly to prevent degenerative diseases. Therefore, it is necessary to develop a product by utilizing the mangosteen pericarp as food for cancer patients. One of them can be as an instant pudding mangosteen pericarp extract, that it is rich in antioxidants. Instant pudding chosen because the process does not require heating temperature is too high, and can be consumed by all kinds of age.

The general objective of the research is to develop the use of mangosteen pericarp as instant pudding for cancer patients. The specific objectives are: 1) to know the mangosteen pericarp extract, 2) to know the content of xanthones and nutrient content (water, ash, protein, fat, carbohydrate) mangosteen pericarp extract, 3) to know how to make of instant pudding with the addition of mangosteen pericarp extract, 4) to analyze the food acceptance of instant pudding products mangosteen pericarp extract, 5) to know the nutritional content (water, ash, protein, fat, carbohydrates) and also the content of xanthones in mangosteen pericarp extract instant pudding.

METHODS

Design and Time

The study design was an experimental study. The study was conducted from May to August 2014 in Sensory Evaluation Laboratory, Laboratory of Food Chemistry and Analysis, Department of Community Nutrition, FEMA IPB.

Materials and The Equipment

The ingredient of making instant pudding mangosteen pericarp extract is an extract of mangosteen pericarp, and supporting materials are: dextrin, powdered

milk, powdered sugar, water. Chemicals used distilled water, 96% ethanol, tartat acid, methanol, hexane solvent, ethyl setat, concentrated H2SO4, selenium mix, NaOH, H3BO3, HCl and methyl red indicator.

The equipment used is : cookware, scales, furnace, Soxhlet, vacuum evaporation, homogenizer, desiccator, condenser, Kjedahl, vortex mixer, centrifuge and Uv-vis spectrophotometer.

Research procedures

Extraction of Mangosteen Pericarp

Dried mangosteen pericarp soaked in 96% ethanol at a ratio of 1: 4 (materials : solvents), then add as much as 1% tartat acid. Maceration performed for 12 hours at room temperature. After the extraction process is completed, the extract was filtered using a filter cloth to obtain a filtrate. The filtrate was added gelatin as much as 0.5% to precipitate the tannin found in mangosteen pericarp, and filtered to obtain a liquid extract of mangosteen pericarp. The extract was dried with a vacuum evaporator at 60°C until all the solvent evaporates and dries. The dried extract was concentrated to 4 L of distilled water and added 15% maltodextrin. Drying is done through spray drying process to obtain extracts of mangosteen pericarp.

Pudding Formulation

Formulation pudding is done by trial and error. The addition of mangosteen pericarp extract is divided into 3 levels, namely (F1) addition of 2.5%, (F2) addition of 5%, and (F3) addition of 100 ml of 7.5% of the total water.

Making Pudding

Making pudding made by mixing all the ingredients basic pudding (1% gelatin, dextrin 5%, 5% powdered milk, powdered sugar 10%) and mangosteen pericarp extract powder based on the levels of each (2.5%, 5% and 7.5% of the 100 ml total water). All of material that has been mixed with added water temperature of ± 80°C. Materials stirring until blended, then poured into a pudding cup and allowed to stand for ± 1 hour at room temperature until it becomes solid.

Sensory Evaluation

Sensory Evaluation (organoleptic) tests carried out of 30 panelists, namely students of the Department of Community Nutrition, FEMA, IPB. Tests carried out with two repetitions. A test includes hedonic and hedonic quality test. Panelists were asked to rate the line scale of 1 to 9. The higher the number, the more like a panelist on the product.

Analysis of Nutritional Value

Analysis of mangosteen pericarp extract powder and the best pudding products are content of nutrient and the content of xanthones. Proximate analysis was conducted on the analysis of the content of water in the oven method (AOAC 1995), ash content by dry ashing method (AOAC 1995), protein content Kjedahl method (AOAC 1995), fat content by hydrolysis Soxhlet method (AOAC 1995) and carbohydrates with by difference. The analysis of antioxidant done by xanthones test (Wijaya 2010).

Design of Experiments and Data Analysis

The experimental design used in this study is complete random design with two replications. Treatments consisted of three levels, namely the addition of mangosteen pericarp extract 2.5%, 5% and 7.5% of the total 100 ml of water. Data were processed and analyzed using Microsoft Excel 2007 and SPSS 16.0 for Windows. Data on the percentage of panelists pudding acceptance mangosteen pericarp extract statistically tested using a test of variance (Kruskal-Wallis).

RESULTS AND DISCUSSION

Extraction of Pericarp Mangosteen

The process of making the mangosteen pericarp extract using maceration method or immersion. The advantages of this method is relatively simple, which does not require complicated tools, easy, inexpensive and can avoid damage to components due to thermal compound (Pebriyanthi 2010).

Mangosteen pericarp which is used was dried mangosteen pericarp from Kaligesing, Central Java, Indonesia. This variety is chosen because it has the characteristics of thick mangosteen pericarp and violet red.

The yield of a product is 14.23%. This number indicates that 2 kg of mangosteen pericarp and the addition of 600 g of maltodextrin, yield 14.23% or as much as 370 g of mangosteen pericarp extract. It is containing xanthones 7666.4

mg of α-mangostin. According to research of Desmawarni (2007), the amount of yield produced by the spray drying process is influenced by several factors. They are : the coating material, emulsifiers and drying process conditions. The yield of the spray drying process results from 5-20%.

The characteristics of mangosteen pericarp extract produced is slight red color, slightly sour aroma, the taste of the powder tends typical of mangosteen peel with a little bit of bitter. The slight red color appears of the pigment anthocyanin which violet red, but after being dried and mixed with maltodextrin color will become sallowness. The sour taste arises because the sap of mangosteen pericarp remaining when added gelatin. Bitter taste arises presumably because there is still tannin.

The Content of Xanthones and Mangosteen Pericarp Extract

When compared with the nutrients in the flour of pericarp mangosteen, mangosteen pericarp extract had lower nutrient content, water content of 4.61%, ash content of 0.57%, protein content of 0.42%, fat content of 0.32% and carbohydrate content of 94.08%. This caused of a maceration process using ethanol, therefore loss of ash, protein and fat contained in the mangosteen pericarp. Besides it, the filler material that is inserted into the pericarp mangosteen extract at the time of spray drying also result in greater carbohydrate content. That is because maltodextrin is used as a filler material of carbohydrates.

Table 1. Content of Mangosteen Extract Pericarp and Pericarp Flour Mangosteen

Component	Unit	Mangosteen Extract Pericarp	Pericarp Flour Mangosteen (Wijaya 2010)
Water	(%bk)	4.61	5.87
Ash	(%bk)	0.57	2.17
Protein	(%bk)	0.42	3.02
Fat	(%bk)	0.32	6.45
Carbohydrate	(%bk)	94.08	82.49
Xanthone	mg/g	20.72	-

Xanthone measurement using a spectrophotometric method at a wave length of 305 nm. The test results show the amount of xanthones found in mangosteen pericarp extract of α-mangostin 20.72 mg/g extract of mangosteen pericarp. This result is smaller when compared with the results Pohtitirat et al. (2008), in which the content of α-mangostin of mangosteen pericarp extract using

methanol reached 356.8–369.2 mg of α-mangostin/g extract. This difference is caused by the difference in the solvent used.

Pudding Formulation

Determining the level used is based on the results of experiments performed previously to the 10 panelists random, to determine the range of the level of addition of mangosteen pericarp extract can be accepted by the panelists. Based on the addition levels of 1% up to 10%, obtained mangosteen pericarp extract additional value which is divided into 3 levels, namely (F1) addition of 2.5%, (F2) addition of 5%, and (F3) addition of 7.5% of the total of 100 g of material. Determination of formulations made with trial-and-error testing.

Pudding Making

The process of pudding making consists of two stages, namely dry mixing, all ingredients as well as the addition of mangosteen pericarp extract (2.5%, 5% and 7.5%) and the addition of boiling water 80°C temperature. The addition of boiling water 80°C temperature is not expected to cause damage xanthones are too big. This process is done not on the stove lit and stirring, so that the temperature of the water will tend to decline. The most important condition and must be considered in making the pudding is steeping water temperatures that are too high can result in damage to the xanthones found in the mangosteen pericarp extract pudding.

Acceptance of Pudding

Color. Hedonic test results to the color indicates the assessment of panelist favorite pudding products ranged between 5.4-5.5 (regular-rather dislikes). Percentage of panelists acceptance of the hedonic quality color ranges between 4.6-4.9 (normal). Results of analysis of variance showed the addition of mangosteen pericarp extract had no significant effect ($p > 0.05$) on the quality of pudding color, and there is no difference ($p > 0.05$) to a panelist. Characteristic slight red on the skin mangosteen powder does not provide bright color in the pudding, so the pudding produced tend to be pale.

The Texture of the Surface of the Press. Hedonic test results to show the surface texture of the press scores range between 6.2-6.4 (somewhat dislike), and hedonic quality test ranged between 5.6-6.2 (somewhat chewy crumbly). Results

of analysis of variance showed the addition of mangosteen pericarp extract had no significant effect ($p > 0.05$) on the quality of surface texture press pudding, and there is no difference ($p > 0.05$) to the panelists. According Setyaningsih et al. (2010), the texture of the surface of the press is one of the mechanical structure of the material (hardness, elasticity). This shows that the addition of mangosteen pericarp extract had no impact on the strength of gelatin in the pudding, so that the three products assessed panelists have the same surface texture.

Aroma. Hedonic test results on the aroma shows fondness assessment of the panelist to three pudding products ranging from 5.8-6.1 (somewhat dislike). Percentage of panelists acceptance of the hedonic quality aromas ranging between 5.5-6.3 (somewhat stronger), while the panelists acceptance of the hedonic quality milk aroma ranged between 5.4-5.8 (regular-a little bit strong). Results of analysis of variance showed the addition of mangosteen pericarp extract had no significant effect ($p > 0.05$) on the quality of milk aroma and flavor pudding, and there is no difference ($p > 0.05$) to the panelist. The weaker aroma, the scent of milk pudding will get stronger. It shows if the aroma of fragrant milk to disguise the scent of pudding which tends to sour.

Flavors. Hedonic test results to demonstrate a sense of flavors assessment of the three pudding products ranged between 5.4-5.8 (regular- a little bit does not like). Percentage of panelists acceptance of the pudding flavors ranging from 5.3-6.1. (regular- a little bit stronger), and acceptance of the sweet taste panelists at the three level of the addition of ranged between 5.1-5.2 (normal). Results of analysis of variance showed the addition of mangosteen pericarp extract had no significant effect ($p > 0.05$) on the quality of sweetness and flavor pudding, and there is no flavors difference ($p > 0.05$) to the panelist.

After Taste. Hedonic quality test results to demonstrate the quality of after-taste pudding ranged between 5.3-5.8 (regular-rather strong). Results of analysis of variance showed that the addition of mangosteen pericarp extract had no significant effect ($p > 0.05$) on the quality of after-taste pudding. The greater the level of addition of mangosteen pericarp extract into pudding, the more powerful after-taste that is perceived by the panelists on the product pudding.

Chewable Texture. The results of the hedonic test showed assessment chewable texture panelist against three pudding products ranging from 6.0-6.2 (somewhat dislike). Percentage of panelists acceptance of the hedonic quality chewable texture ranged between 5.2-5.8 (somewhat strong-usual). Results of analysis of variance showed the addition of mangosteen pericarp extract had no significant effect ($p > 0.05$) on the quality of the pudding chewable texture, and there is no difference ($p > 0.05$) to panelist.

Based on sensory evaluation test results hedonic and hedonic quality, best formula according to panelists is F1 (2.5% mangosteen pericarp extract).

Nutrient of Pudding

Mangosteen pericarp extract contains xanthones are high, it can be improve the xanthones in the pudding product that are useful for preventing cancer (Obolskiy et al. 2009). The results of the analysis of the nutrient of selected puddings are presented in Table 2.

Table 2. Nutrient Content of Selected Pudding (100g)

Component	Unit	Selected Pudding
Water	(%bb)	78.16
Ash	(%bb)	0.84
Protein	(%bb)	1.12
Fat	(%bb)	1.34
Carbohydrate	(%bb)	18.40
Xanthone	mg	159
Energy	(kkal)	90

The results of the analysis of water content pudding mangosteen pericarp extract was 78.16% (bb). Ash content pudding mangosteen pericarp extract was 0.84% (bb). Protein content pudding mangosteen pericarp extract was 1.12% (bb). According to WNPG 2004, Protein Adequacy Score (AKP) of Indonesian the average is 52 g per day or 5.2 g contribution as snack. There is 1.12 g protein in the pudding of 100 g, its mean that in 100 g pudding that can meet the needs at the snack time of eating pudding at 21.5% AKP. This figure is still not sufficient for the average protein of Indonesian at the snack time consumption.

Fat content of mangosteen pericarp extract pudding products chosen by 1.34% (bb), equivalent to 12.06 kcal. According to IOM 2005, the recommended proportion of energy from fat is 25% per day, or 2.5% contribution for a snack

time. In 100 g pudding are 12.06 kcal fat, so it can meet the 100 g pudding 24.12% the recommended proportion of energy from fat. There are 12.06 kcal in 100 gr g fat pudding, it's mean that 100 g of pudding can meet the recommended proportion of 24.12% of energy from fat.

Carbohydrate of pudding mangosteen pericarp extract is selected by 18.40% (bb), it is equivalent to 73.6 kcal. According to IOM 2005, the recommended proportion of energy from carbohydrates is 65% per day, or 6.5% contribution for a snack time. For 100 g pudding is 73.6 kcal carbohydrates, it's mean that 100 g of 56.6% pudding can meet the recommended proportion of energy from carbohydrates.

The energy of the pudding mangosteen pericarp extract is obtained by converting proteins, fats and carbohydrates into energy. Based on calculations, the energy of the mangosteen pericarp extract pudding products selected by 90 kcal, while the energy content in instant pudding gelatin is equal to 86 kcal. Both of them have an energy content that is not too far away. According to WNPG 2004, Figures of Energy Adequacy Score (AKE) Indonesian the average is 2000 kcal per day or 200 kcal contribution to snack. In 100 g pudding contained 90 g kcal, so that 100 g of pudding can meet the requirement consumption by 45% snack AKE. This figure is still not sufficient for the average protein Indonesia at the time of consumption of snack.

Levels of Xanthone

The amount of xanthones in mangosteen pericarp extract pudding is 1.59 mg α-mangostin/g pudding. According to Permana's research (2012), mangosteen pericarp extract has antioxidant capacity almost equivalent to ½ times the capability ascorbat acid can reduce free radicals.

Akao et al. (2008) in his research suggests the provision of xanthones diet of 150 mg/day for a healthy person is able to increase the activity of Natural Killer cells (NK). These cells work as the primary immune cells of innate immunity, and very important in inhibiting tumor cells and cells infected with viruses. One serving of pudding mangosteen pericarp extract (230 g) contains of 366 mg of α-mangostin. This amount meet the recommended minimum amount

required to be able to inhibit tumor growth. Product pudding mangosteen pericarp extract is rich in xanthones and its good for cancer patients.

Nutrient Content Per Serving

The pudding of mangosteen pericarp extract can be as an alternative snack. The amount of the contribution of the recommended daily is 10-15% for the average person needs adult Indonesian, energy 2000 kcal and 52 g protein (WNPG 2004). Based on the calculations, it is known that the amount of energy required at the time snack of 200 kcal and 5.2 g protein. Calculation servings of pudding refers to the energy and protein needs of the average person of nutrition adequacy score (AKG) Indonesia. Nutrient content per serving pudding mangosteen pericarp extract is presented in Table 3.

Table 3. Nutrient of Pudding Mangosteen Pericarp Extract per serving

Pudding mangosteen pericarp extract (g)	Nutrient Content				
	Energy (kcal)	Protein (g)	Fat (g)	Carbohydrate (g)	Xanthone mg/g
100	90	1.12	1.34	18.40	159
230	207	2.58	3.08	42.32	366

One serving pudding is used to meet the nutritional needs during snack time is 230 g. The pudding accounted for 207 kcal of energy equal to 100% AKE when snack time. Contribution of 2.58 g protein equivalent to 49.6% when the AKP snack time. Contribution of 3.08 g fat, carbohydrates and xanthones of 42.32 g of 366 mg of α-mangostin.

Estimation Price of Pericarp Extract Mangosteen Pudding per Serving Size

Table 4. Estimation Price of Pericarp Extract Mangosteen Pudding per Serving Size (230 g)

Comparation	Pericarp Extract Mangosteen Pudding	Commercial Pudding
Product weight (gr)	230	230
Price (Rp)	5 500	7 350

Pudding price of mangosteen pericarp extract per serving size (230 g) was Rp 5 500. Commercial pudding price per serving (230 g) is Rp 7350. Pudding mangosteen pericarp extract is cheaper than the price of commercial pudding.

CONCLUSION

Mangosteen pericarp extraction method by maceration or soaking with ethanol. The water content in the mangosteen pericarp extract of 4.61%, ash

content of 0.57%, protein content of 0,42%, fat content of 0.32%, carbohydrate content of 94.08% and the xanthone content of 20.72 mg α-mangostin/g extract of mangosteen pericarp. Formulation pudding made with mangosteen pericarp extract is 3 level differences, they are : 2.5%, 5% and 7.5% of 100 g of total primary material. The results of sensory evaluation test showed that panelists tend to like the product of F1 with additional level of mangosteen pericarp extract as much as 2.5%. Based on the test results of variance (Kruskal-Wallis), there is no significant differences between the formula in each attribute. The water content of the product is equal to 78.16% of pudding, ash content of 0.84%. Nutrient content of pudding mangosteen pericarp extract per serving (230 g) is the energy of 207 kcal, protein of 2.58 g, fat of 3.08 g, carbohydrates of 42.32 g and xanthone content of 366 mg of α-mangostin. The estimate price of pudding per serving is Rp 5 500. The pudding price of mangosteen pericarp extract cheaper than the price of commercial puddings sold in the market.

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