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Macronutrients Analysis in Ipomoea Batatas L. Poiret as an Alternative Food in Improving Nutritional Adequacy of Pregnant Women

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Abstract

Background: Adequacy of nutritional intake in pregnant women is needed in order to deliver healthy babies. Inability to provide nutritional needs due to financial problems is a common issue. Diversification of cheap and affordable food is needed for pregnant women so they will be avoided forvarious pregnancy complications. The objectives of this study are conducting a nutritional content analysis of *Ipomoea batatas L. poiret* as an alternative food to improve the nutritional status of pregnant women as well as examine the pattern of macronutrient consumption during pregnancy with the growth of the pregnancy.

Method: There are two designs used in this study (1) a field quantitative with completely randomized design, a laboratory experimental design, and (2) retrospective correlational design with cross-sectional study. The study samples are *Ipomoea batatas* and pregnant women in the second and third trimester with simple random sampling. Data analyses used in this study are proximate analysis in *Ipomoea batatas* and chi-square in pregnant women.

Results: The macronutrients content of 100 gr dry *Ipomoea batatas* are 84.08 carbohydrates, 1.00 gr proteins, and 2.22gr fats. Macronutrient consumption analysis obtained p-value 0.03 for carbohydrates, 0.02 for proteins, and 0.14 for fats which means that there is a correlation between carbohydrates, proteins, and fats with an increase of body mass index in pregnant women.

Conclusion: *Ipomoea batatas*can be an alternative macronutrient source for mother's needs during pregnancy.

Keywords: *Ipomoea batatas, nutrition, pregnant women.*

Introduction

Issues in nutrition are still a major public health problem in Indonesia[1][2].Malnutrition in mothers and babies has contributed to around 3.5 million deaths annually and approximately 11% of disease globally as well as reaching 30% of the total world population[3][4]. According to Ethiopian Demographic and Health Survey (EDHS) for developing countries, the malnutrition problem in Kerala (India) is around 19%, while same number of 34% in Bangladesh and the slums area of Dhaka[5]. Anemia during pregnancy and chronic energy deficiency (CED) are an impact of malnutrition and can increase the risk of born prematurely and low birth weight babies[4][6].

Basic health research (riskesdas) in Indonesia (2013) showed that CED is still the main problem in pregnant women since there is a 7.2% increase in the prevalence from 31.3% in 2010 to 38.5% in 2013[7][8]. The main cause of chronic energy deficiency in pregnant women is an unbalance between the need for food during pregnancy and food intake in sufficient quantities[9][10] with several indirect factors are socioeconomic, short birth interval, parity or number of babies born, early age of first pregnancy, and low education[11].

Mothers need adequate nutrition during pregnancy. Diversification of cheap and affordable food is needed toavoid various pregnancy complications[10][12]. Nutritional needs that must be fulfilled include energy,

protein, vitamins, folic acid, calcium, iron, iodine, zinc, flour, and its amounts must be adjusted to the gestational age[12][13].

Rice consumption standards according to Food and Agriculture Organisation is 60-65 kg/capita/year[5][14][15]. The national social-economic survey by the Indonesian central bureau of statistics (2017) reported thatIndonesian people consume 114.6 kg/capita/year of rice from 2002 to 2017, that is why Indonesia is categorized as Asia's number one consumption of rice as a staple food.This number needs to be reduced by decreasing the dependence on rice consumption through diversifying food consumption[4][15].

*Ipomoea batatas*is one of the main sources of carbohydrates and has an important role in providing an alternative foodand opportunity to replace rice as the main foodstuff of Indonesian people[16][17].Theconcept of food source substitution will have an important role in food diversification and can be processed into a variety of products that can encourage the development of agro-industry[18][12].One of the benefits of products made from*Ipomoea batatas* is improving the nutritional adequacy of pregnant womensince it contains vitamin A, C, E, betacarotene, magnesium, potassium and antioxidants[19].

This study aims to conduct a nutritional content analysis of *Ipomoea batatas L. poiret* as an alternative food to improve the nutritional status of pregnant women as well as examine the pattern of macronutrient consumption during pregnancy with the growth of the pregnancy.

Material and Method

a. **Study design and setting:** There are two designs used in this study (1) a field quantitative with completely randomized design, a laboratory experimental design to identify macronutrients content in *Ipomoea batatas*, (2) retrospective correlational design with cross-sectional study to assess macronutrients consumption habits in pregnant women by food frequency questionnaire (FFQ) for 3 months related to pregnancy growth through body mass index (BMI).

b. **Sample:** The main sample in this study was *Ipomoea batatas* with two times of test in a fresh and dried condition in the form of flour.

   1. Materials and tools to analyze macronutrient contents in *Ipomoea batatas*.

      The materials used in this study were local *Ipomoea batatas* which have been washed with tap water. The chemicals used were HCl (Merck), NaOH (Merck), aquadest, H2SO4 (Merck), Na2SO4 (Merck), K2SO4 (Merck) and n-Hexan (Merck).Tools used in this study were scales, knives, plastic containers, slicers, abrasion peeler, dryer cabinet, 80 mesh sifter, freeze dryer, and oven. The tools for physic and chemical identification were analytic scale, spectrophotometer UV-VIS 200S, and HPLC waters e2695 separations module.

   2. **Women pregnancy:** Macronutrients consumption habits assessment in pregnant women were those in the second and third trimester with the criteria including the mothers do not experience with hyperemesis, chronic infections, and willing to join assessment program for daily nutritional consumption for the last 3 months. The sampling technique used in this study was simple random with the number of participants were 100 pregnant women in the district of Jember-Indonesia.

c. **Data collection and instrument:** Data collection techniques are carried out using a structured interview form and questionnaire about sociodemographic characteristics, pregnancy history, and food consumption during pregnancy. Daily macronutrient consumption habitscollected using FFQwhich was modified to assess eating habits in the last 3 months. BMI of mothers obtained through weight and height measurement.

d. **Data analysis:**

   1. **Analysis of Ipomoea batatas for laboratory experimental design** Laboratory testing is carried out using proximate analysis in *Ipomoea batatas* to identify macronutrient content.

   2. **Analysis of micronutrients consumption in pregnant women** Statistical analysis used in this study ischi-squareto assess the consumption habits of macronutrients in pregnant women with a BMI.

Findings:

1. **Study result in Ipomoea batatas:** Proximate analysis in this study used to identify carbohydrate, protein, and fat content in 100 gram*Ipomoea batatas L.*

Table 1. Macronutrients composition in 100 grams *Ipomoea batatas* by proximate analysis

No	Macronutrient content	Fresh Ipomoea batatas			Dry Ipomoea batatas		
		UI 1	UI 2	Rata2	UI 1	UI 2	Rata 2
1	Carbohydrate (gr)	25.80	25.18	25.49	84.00	84.16	84.08
2	Fat (gr)	0.4	0.6	0.5	0.94	1.07	1.00
3	Protein (gr)	0.70	0.90	0.80	2.31	2.14	2.22

Ipomoea batatas also has macronutrients such as carbohydrates, protein, and fats which needed to help the growth of the fetus.Based on proximate laboratory tests it was found that the highest carbohydrate content was found in dried Ipomoea batatas with an average rate of 84.08 grams. While the fat composition of about 1% in dried Ipomoea batatas and 2.22 grams of dried Ipomoea batatas protein content.

2. Study result in pregnant women

a. Respondent characteristics

Table 2. Respondent characteristic based on age, education level, occupation of mother, and pregnant status (n=100)

Variables	n	Percentage
Age of mothers		
< 20 years old	24	24
20-30 years old	57	57
> 30	19	19
Education level		
Elementary school	17	17
Junior high school	47	47
Senior high school	23	23
College	3	3
Occupation		
Housewife	65	65
Private sector	16	16
Labor	19	19
Pregnant status		
Primigravida	49	49
Multigravida	51	51

Based on the frequency data, it was found that most of the pregnant women were 20-30 years of age, junior high school education and were not working.

b. Macronutrient consumption analysis with the growth of pregnancy

Table 3. Carbohydrate consumption with body mass index (n=100)

BMI	Carbohydrate consumption		Total	OR95% CI	P value
	Not fulfilled	Fulfilled			
Not appropriate	75	25	100	4.286	0.03
Appropriate	41.2	58.8	100	1.683–10.9127	
Total	52	48	100		

There is a relationship between carbohydrate consumption with BMI of pregnant women with OR 4.286 that means the mothers whose carbohydrate consumption patterns are not fulfilled have a 4.286 times chance of having an appropriate BMI.

Table 4. Fat consumption with body mass index (n=100)

BMI	Fat consumption		Total	OR95% CI	P value
	Not fulfilled	Fulfilled			
Not appropriate	46.9	53.1	100	3.403	0.14
Appropriate	20.6	79.4	100	1.370-8.453	
Total	29	71	100		

There is a relationship between fat consumption with BMI in pregnant women and OR analysis found that mothers whose fat consumption was not fullfiled had a 3.403 times chance of having an appropriate BMI.

Table 5. Protein consumption with body mass index (n=100)

BMI	Protein consumption		Total	OR95% CI	P value
	Not fulfilled	Fulfilled			
Not appropriate	45,1	54,9	100	4,371	0,02
Appropriate	19,6	80,4	100	1,76 - 10,857	
Total	29	71	100		

There is a relationship between protein consumption with BMI and OR analysis found that mothers whose protein consumption was not fulfilled had the opportunity to have 4.37 times appropriate BMI.

Discussion

Macronutrients are substances needed by the body in large numbers to provide direct energy[20][21].In pregnant and lactating women, intake of macronutrients acts as forming organs and fetal cells[14][21]. The results of this study about macronutrient consumption habits in mothers showed an association with pregnancy growth as measured by BMI[22][23].Macronutrients are very important in pregnant women to get balanced nutrition and growth of the fetus[24][25]. Rice is the number one consumption of Indonesian people as a staple food, even though there are many cheaper and have complete nutritional content from other sources of macronutrients.

Ipomoea batatas is one of Indonesia's agricultural products which has high carbohydrate content to providethe nutritional needs of pregnant women[18][16]. Mothers need additional 300 kcal of nutrients per day during pregnancy from macro and micronutrients[26][12]. Additional macronutrient requirements are 20 gr/day protein, 10 gr/day fat and 40 gr/day carbohydrate.84.08 grams carbohydrate content in 100 grams dry *Ipomoea batatas* is bigger than in fresh one that just 25.49 grams. The increased in macronutrients need during pregnancy is used to provide the need for metabolic changes and fetal growth[15].This result suggests that *Ipomoea batatas*is very potential to replace rice as a source of food. Carbohydrate has an important role to maintain circulation and protein synthesis during pregnancy[19][27]. Anemia during pregnancy and CED can increase the risk of born prematurely and low birth weight babies[28][4].

Ipomoea batatas also has protein content that needed for fetal growth as well as a source of calories, synthesis of enzymes and hormones, muscles and other body tissues, blood cell formation, growth of the placenta and brain development[6][12]. The result of proximate analysis showed that dry *Ipomoea batatas*has 2.22 grams/100 gramprotein content which can help to provide 15% of protein needs.Indicator for the maternal proteinadequacy assessment can be measured through maternal weight and fetal growth[29]. Chronic energy and protein deficiency during pregnancy can reduce the nucleus in both DNA and RNA that affect to disruption of the maternal nutrients transfer to the fetus and lead to low birth weight babies and intra uteri growth retardation (IUGR)[9][29].

Fat, especially omega 3 and 6 are important to increase birth weight and fetal growth as its main role in providing metabolic energy. Saturated and unsaturated fatty acids have resulted from fat metabolism[9][30]. Docosahexaenoic acid (DHA) and arachidonic acid (AA) is a long-chain unsaturated fatty acid derived from diffused lipids and useful for the growth and development of the fetus[2][15].*Ipomoea batatas* which has an optimal content of fat indicates that this food is safe for pregnant women daily consumption since the result of proximate analysis is 1 gram/100 grams fat content[27][16].

Ipomoea batatas is local food sources that are able to be an alternative food source in providing the adequacy of nutrition in pregnant women[5].The complete macronutrient content and some of the micronutrient contents in *Ipomoea batatas*make this food feasible and safe for pregnant women to consume and can be a food substitute for rice[31][29].

Conclusion

As a cheap source of carbohydrates, *Ipomoea batatas* have great potential as ingredients that can provide the

nutrition of mothers during pregnancy. *Ipomoea batatas* also has macronutrients such as carbohydrates, protein, and fats which needed to help the growth of the fetus.

Statistically showed that there is a significant relationship between macronutrient consumption of pregnant women with fetal growth as measured by BMI.

Conflict of Interest: None

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Ethical Clearance: This study has passed and got an ethic approval (No: 1142/II.3.AU/FIKES/O/2019) from Faculty of Health Science University of Muhammadiyah Jember.To ensure confidentiality, the research sample data is given a code number.

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