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**Research Article**

# The Effect of Giving Rice Bran Milk on Blood Glucose Levels and Body Weight in Hyperglycemic Primary School Teachers in Makassar City

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**ABSTRACT**
This study aims to determine the effect of rice bran milk on fasting blood glucose levels and body weight of primary school teachers in Makassar City. This study was quasi-experimental with pretest-posttest with control group design. The population is all primary school teachers in Makassar City who have abdominal circumference > 80 cm for woman and >90 for men. The samples are those who meet the inclusion criteria who had fasting blood glucose levels >100 mg/dL, do not consume drugs. Sample selected then randomly divided in to experimental and control group, each group consist of 12 participants. Provision of rice bran milk was given once a day (30 gram) and nutritional education for one month for experimental group and only nutritional education once a day through WhatsApp media for the control group. Blood Glucose level, body weight and 24H dietary recall was reported before and after study both for experiment and control groups. The data were analyzed by paired t-test and experimental independent samples t-test, using SPSS. The results of this study showed that, in experimental group, the fasting blood glucose level reduced significantly ($p<0.05$) but increased in the control group after intervention there were also a significance differences between fasting blood glucose level in experimental and control group ($p<0.05$). There were a significance differences between body weight before and after intervention in intervention group ($p<0.05$) but not in control group and there were also significance differences of body weight between experimental and control groups at posttest. Conclusion, rice bran milk can be used as nutritional supplements for the control of hyperglycemia and body weight of overweight and diabetic individuals.

**Keywords**: rice bran milk, hyperglycemia, diabetes, blood glucose, body weight

## INTRODUCTION

Non-Communicable Diseases (NCD) has become a major concern in public health issues, this is marked by the shift in epidemiological patterns of disease from infectious diseases to non-communicable diseases that continue to increase both nationally and globally, one of which is Diabetes Mellitus (DM). DM is a degenerative disease whose prevalence is expected to continue to increase from year to year. According to the International of Diabetic Federation (IDF), in 2019, approximately 463 million adults (20-79 tears) worldwide were living with diabetes this is predicted to rise to 578 million by 2030 and to 700 million by 2045 (International Diabetes Federation, 2019).

NCD, including Diabetes, have now become a serious threat to global health. 90-95% of cases of Diabetes are Type 2 Diabetes which is largely preventable because it is caused by an unhealthy lifestyle. Indonesia also faces a situation with the threat of diabetes similar to the world. The International Diabetes Federation (IDF) Atlas 2017 reports that, the Diabetes epidemic in Indonesia is still showing an increasing trend. Indonesia is the sixth ranked country in the world after China, India, the United States, Brazil and Mexico with the number of people with diabetes aged 20-79 years, around 10.3 million people (International Diabetes Federation, 2017).

Based on Basic Health Research shows a significant increase in the prevalence of Diabetes, from 6.9% in 2013 to 8.5% in 2018; so, the estimated number of sufferers in Indonesia reached more than 16 million people who were then at risk of diabetic complications, such as: heart attack, stroke, blindness and kidney failure can even death. Diabetes is a global epidemic problem which if not treated immediately seriously will result in an increase in the impact of significant economic losses, especially for developing countries in Asia and Africa. IDF data also shows that the direct costs of managing diabetes reach more than 727 billion USD per

year or around 12% of global health financing. The National Health Insurance Data (JKN) also shows an increase in the number of cases and financing of Diabetes services in Indonesia from 135,322 cases with funding of Rp 700.29 billion in 2014 to 322,820 cases with funding of Rp 1,877 trillion in 2017 (Kementerian Kesehatan Republik Indonesia, 2018).

The increasing prevalence of NCD, has led to changes in people's attitudes, which tend to be more trying to prevent disease and implement healthy living. The emergence of various functional food products can be an alternative in preventing several types of diseases that arise both due to genetic factors, lifestyle and diet. One ingredient that has the potential to be used as functional food is rice bran (Tuarita et al., 2017).

Rice bran is a by-product of the rice milling process is abundant in Indonesia. Rice production in 2016 reached 79.141 million tons of Dry Grain Paddy and in 2017 rice production reached 81.38 million tons (Indonesian Agricultural Departemen, 2017). The percentage of bran from milled dry grain is around 10%. So far, most of it is only used as animal feed (Indonesian Agricultural Departemen, 2017). The results research showed that, rice bran is a good source of bioactive phytochemicals, namely or-oryzanol, vitamin E group (tocopherols and tocotrienols) and flavonoids as well as macro nutrient content such as protein, fiber, fat and carbohydrates. The phytochemical compound have health beneficial properties and antioxidant activities[4,5,6]. (Moongngarm et al., 2012; Rohman et al., 2014; Watchararuji et al., 2008). With this nutritional content, efforts can be made to diversify food that can provide added value to rice bran not just an animal feed. Some research found that the content of gamma oryzanol and fiber in rice bran can reduce blood glucose levels (Devarajan et al., 2016; Qureshi et al., 2002; Sivamaruthi et al., 2018; Tazakori et al., 2007) and other research found that rice bran can increase blood glucose levels (Lai et al., 2011).

Besides can decrease blood glucose level, rice bran also found as a source of fiber which have a functions to decrease blood pressure, control blood glucose level, decrease body weight and increase the immunity (Anderson et al., 2009). Many studies support the inverse relationship of dietary fiber and the risk for CHD. However, more recent studies found interesting data illustrating that for every 10 g of additional fiber added to a diet, the mortality risk of CHD decreased by 17–35% (Pereira et al., 2004; Streppel et al., 2008). Risk factors for CHD include hypercholesterolemia, hypertension, obesity and type two diabetes. The results of one larger clinical study, supports this theory in their finding that for every 20 g/d increase in consumption of bran, body weight decreased by 0.80 lbs (Kochi-Banerjee et al., 2004).

The main aim of this study was to investigate the effect of rice bran milk on glucose levels and body weight in hyperglycemic.

## MATERIALS AND METHODS

### Materials

Rice bran used in this research was obtained from rice mill PB. Rice bran taken directly from the rice mill was directly roasted using low heat for approximately 10 minutes, then sieved using a 60-mesh sieve. The rice bran was then made a rice bran milk by adding Arabic gum as an emulator, corn sugar as a sweetener, sodium bisulfite as a preservative and melon flavoring as flavor and odor.

### Methods

This study was Quasi experimental design with pretest-posttest with control group design. A total of 24 primary school teachers with hyperglycemic were screen from all primary school teachers in Makassar City who meet the criteria: have abdominal circumference >80 cm for woman and >90 for men. For those who had fasting blood sugar levels >100 mg/dl. Fasting blood glucose levels was determined by Prodia Laboratory after fasting for 8 hours. Exclusion criteria: liver disease, using anti diabetic medicines, and pregnancy or lactation for women participants. Those subjects who have blood glucose levels >100 mg/dl randomly divided to experimental and control group; each group consist of 12 participants. Provision of rice bran milk was given once a day (30 gram) for one month for experimental group and nutrition education for the control group also once a day through WhatsApp media. Fasting blood glucose levels were measured twice, before and after the study and 24-hour recall of food were checked before and after study. The data were analyzed by paired t-test and independent sample t-test using SPSS and Food processor.

The study was approved by the Institutional Review Board of Faculty of Public Health Hasanuddin University, (Approval number: 6156/UN4.14.8/TP.02.02/2019 – July 25, 2019). Each participant provided written consent before participating in the study.

## RESULTS

### Characteristics of Subjects

Out of 24 subjects entered the study, both group experiment and control, dominated by women, average age for group were lower (about 48

years old) while control group (about 54 years old) (Table 1).

**Table 1. Characteristics of respondent based on sex and age**

| Variable | Experimental Group (n=12) | Control Group (n=12) |
|---|---|---|
| **Sex** | | |
| - Men | 5 | 1 |
| - Women | 7 | 11 |
| **Age (Years)** | | |
| - Minimum | 29 | 49 |
| - Maximum | 60 | 57 |
| - Average | 48.75 | 54.58 |
| - Std | 8.29 | 3.31 |

**The effect of rice bran milk on fasting of Blood Glucose**

Fasting blood glucose level examination results are shown in Table 2. The average fasting blood glucose levels in experimental group, before intervention were 217,00 ± 88,24 mg/dl and 182,75 ± 61,46 mg/dl after the intervention, it means that there was a decrease value equal to 34.25 ± 26,78 mg/dl (15,78%); while in the control group were 141,17 ± 48,46 before intervention and 143,58 ± 54,59 after the intervention period, it means that there was an increase value of fasting blood glucose levels equal to 2.41± 6.13 mg/dL. The results of statistical test (paired t-test) showed that there was a significant decrease of fasting blood glucose before and after intervention in the experimental Group ($p<0.05$), but in control groups there was no significance differences. The results also showed that, there was a significance difference of fasting blood glucose levels on pre-test between experiment and control group ($p=0.018$) but there were no significance differences of fasting blood glucose level on post-test between experimental group and control groups ($p>0.05$).

**Table 2. The Effect of Rice Bran Milk on Fasting Blood Glucose Levels of Hyperglycemic and controls Elementary School Teachers in Makassar City**

| | Experimental Group | | Control Group | | p |
|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | |
| Fasting blood glucose (mg/dL) | 217,00 ± 88,24 | 182,75 ± 61,46 | 141,17 ± 48,46 | 143,58 ± 54,59 | 0.018[a] 0.113[b] |
| P | 0.020[c] | | 0,569[d] | | |

[a] Two independent sample t-test – the differences between fasting blood glucose levels in pre-test
[b] Two independent sample t-test – the differences between fasting blood glucose levels in post-test
[c] Paired t-test – differences between fasting blood glucose levels before and after test for experimental group
[d] Paired t-test – differences between fasting blood glucose levels before and after test for control group

**The effect of rice bran milk on Body Weight**

**Table 3. The Effect of Rice Bran Milk on Body Weight of Hyperglycemic and controls Elementary School Teachers In Makassar City**

| Weight (Kg) | Experimenta Group | | Control Group | | P |
|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | |
| Average ± std | 72,79± 12,41 | 70,73± 11,82 | 58,12± 9,81 | 57,55 ±9,80 | 0.004[a] 0.007[b] |
| P | 0.042[c] | | 0,130[d] | | |

[a] Two independent sample t-test – the differences of body weight between intervention and control groups at pre-test
[b] Two independent sample t-test – the differences of body weight between experimental and control groups at post-test
[c] Paired t-test – differences between body weight before and after test for intervention group

Paired t-test – differences between body weight before and after te for control group Table 3 showed that, the experimental group had a significance loss in weight ($p<0,05$). The average reduction in weight was about 2,06 kg after administration rice bran milk for one month, namely 72,79 ± 12,41 kg in pretest to 70,73 ± 11,82 kg in post-test, it means that, the reduction about 2,83%, while in control group there was also reduction but not significant between pre and post-test ($p=0,130$). If we compare body weight between groups at posttest, there was also a significant difference ($p<0,05$).

**The results of 24H Recall Diet**

The reported data of the respondent's food intake through a 1 x 24-hour food recall were analyzed with a nutrisurvey. Recall was done twice, before the intervention and the day after the intervention ends. The results of the analysis including energy (kcal), carbohydrate (g), protein (g), fat (g), fiber (g) and cholesterol (mg) which are shown in Table 4. The results showed that, dietary intake did not change over the study interval. The mean energy, protein, fat, carbohydrate, cholesterol and fiber intakes were not significantly different between pre and post-test, and also between groups ($p>0.05$). The measurement results show that, in experimental group, there were a decrease in the average intake of energy, protein, fat, carbohydrate and cholesterol before and after intervention, while for the fiber where was increased. In control group (nutritional education group), all item was decrease but also not significant.

**Table 4. The results of 24-hour Food Recall before and after intervention in Experimental and Control groups**

| Daily Intake | Experimental Group n=12 | | | Control Group n=12 | | | p-value Experiment Vs Control |
|---|---|---|---|---|---|---|---|
| | Pre | Post | p- | Pre | Post | p | |
| Energy (kcal) | 1127.52±426 | 1151.67±531.89 | 0.838 | 1184.73±434.14 | 1047.09±533.33 | 0.332 | 0.529 |
| Protein (g) | 45.52±21.77 | 52.78±29.64 | 0.416 | 46.94±22.29 | 41.23±22.23 | 0.454 | 0.894 |
| Fat (g) | 39.92±29.27 | 42.73±28.75 | 0.690 | 42.14±30.96 | 35.73±33.85 | 0.483 | 0.748 |
| Carbohydrate (g) | 147.86±67.27 | 141.53±63.31 | 0.624 | 156.18±65.98 | 140.41±69.69 | 0.256 | 0.229 |
| Fiber (g) | 7.03±4.21 | 7.30±5.98 | 0.878 | 8.30±5.28 | 5.70±3.19 | 0.135 | 0.352 |
| Cholesterol | 186.96±186.91 | 230.28±188.88 | 0.450 | 211.94±190.29 | 222.342±234.34 | 0.884 | 0.544 |

## DISCUSSION

The aims of this study was to determine the effect of rice bran milk on fasting blood glucose levels and body weight of hyperglycemic primary school teachers. Antioxidant compounds contained in rice bran can be grouped into 6 groups, including phenolic acids, flavonoids, anthocyanins and proanthocyanins, tocopherols and tocotrienols, ϒ-oryzanol and phytic acids (Goufo & Trindade, 2014). The main antioxidant in rice bran is ϒ-oryzanol[2] (Tuarita et al., 2017). Antioxidants are able to neutralize excess free radical compounds in pancreatic β cells by donating electrons or cutting off free radical chain reactions and causing free radicals to become stable. So that this can stop or inhibit oxidative damage to pancreatic β cells (Dewi et al., 2014). ϒ-oryzanol can also increase glucokinase activity and inhibit glucose 6-phosphatase and phosphoenolpyruvate carboxinase in the liver. This increased activity can increase the utilization of blood glucose into energy or glycogen storage in the liver, thereby causing decrease blood glucose concentration (Son et al., 2015). Other antioxidants, namely flavonoids contained in rice bran, can prevent complications or progression of diabetes mellitus by clearing excessive free radicals, breaking the chain of free radical reactions, binding of metal ions (chelating), and blocking the polyol pathway by inhibiting the enzyme aldose reductase. Flavonoids also have an inhibitory effect on the alpha glucosidase enzyme through hydroxylation

bonds and substitution in the ß ring. The principle of inhibition is similar to acarbose which has been used as a drug for the treatment of diabetes mellitus, namely by producing carbohydrate and disaccharide delays and glucose absorption and inhibiting the metabolism of sucrose into glucose and fructose (Prameswari & Widjanarko, 2014; Salehi & Sardarodiyan, 2016).

As we found in this study, there were a significant decrease of fasting blood glucose levels on experimental group (p=0.02) and in control group the blood glucose levels tend to increase but not significant. There were also found that in pre-test, there were a significance differences of fasting blood glucose between experiment and control group (p=0.016) and in post-test there were also differences but not significant. Base on this results we can say that, provision of rice bran milk were good because can decrease the blood glucose levels. This is in line with the research results of Cheng et al. (2010) that provision of rice bran 20 g/day for 12 weeks can reduce glucose levels (Cheng et al., 2010). This also in line with Devarajan et al. (2016) that provision of rice bran oil blend with sesame oil can reduce fasting blood glucose levels (Devarajan et al., 2016). In control group, there was an increase in fasting blood glucose levels after the intervention period. Increasing fasting blood glucose levels in control group was in line with the research results of Lai, M.H. et al. (2012) that consumption of 18 g rice bran oil modified milk daily for five weeks could increase 11 g/dL fasting blood glucose levels (Lai et al., 2011). The results of this study also showed that, there were just a little decrease in blood glucose levels in the experimental groups, these maybe caused by an increase fat consumption of the experimental group. This results in line with the research results of Kim et al.(2010) that, high fat-feed resulted in increase in the blood glucose levels in mice (Kim et al., 2010).

The effect of rice bran administration on weight loss in this research not provide adequate results, because the weight loss was too small, although the results of the reduction were significant (p<0,05), this may be due to the short time of administration, which is only 30 days. The results of this study are in line with the results of the study of Edrisi et al. (2017) which shows that, by administered rice bran for 12 weeks can significantly reduce weight (p <0.01) (Edrisi et al., 2018). The same results also found by Zavoshy et al. (2012) that body weight were significantly reduced after four weeks consumption of rice bran oil (30g/day) (Zavoshy et al., 2012). The research results by Hongu et al. (2014) showed a decrease body weight for about 4.7 kg after the administration of a snack bar which was a mixture of rice bran and plant sterol for eight weeks (Hongu et al., 2014).

The strengths of this study were used quasi experimental design with pre test-post test with control group design, for the exclusion of individuals who were consuming drugs or conditions that may have altered metabolism. Our study population was hyperglycemic and obese adults. A limitation of this study is the relatively low number of participants through the study was powered based on expected reduction of blood glucose and weight loss. Another potential limitation of this study is the relatively short dietary intervention period (4 weeks). Though this interval did allow for an average weight loss of 2,06 kg, it did not allow for the assessment of long-term effects, which should be considered in future studies with rice bran.

## CONCLUSION

Results of this study showed that, giving rice bran milk 30 gram for one month, once a day can decrease significantly blood glucose levels of hyperglycemic people and also can reduce body weight.

## CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest

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