

RESEARCH ARTICLE

The Effects of Fermented Rice *Monascus purpureus* *JmbA3'K* to Blood Pressure and Heart Rate Elderly Woman

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Abstract

Incidence of hypertension is increasing rapidly, in 2000 more than 25% of the world's population of hypertension estimated in 2025 increased to 29%. The incidence of hypertension, especially in women will increase at the age of post menopause so it needs to be prevented in elderly women, especially with giving functional food that has effect to lowering blood pressure. Gamma-aminobutyric acid (GABA) is a compound that has the properties of lowering blood pressure through the regulation of smooth muscle tone of blood vessels contained in seeds fermented by *Monascus purpureus* sp. This research was a case control study which conducted in June 2013 to 19 women within age range 60–80 years who life in Santana Nursing Home, Cirebon to find out the influence of giving fermented rice *M. purpureus JmbA3'K* to systolic/diastolic blood pressure and heart rate of elderly women. Subjects were given 3 g of fermented rice *M. purpureus JmbA3'K*. Blood pressure and heart rate was monitored daily. The Wilcoxon signed-rank test was done to see whether the effect of giving fermented rice from the local *M. purpureus JmbA3'K* to the systolic and diastolic blood pressure of the elderly and the mean difference test using paired t test was done to see if the effect of fermented rice from *M. purpureus JmbA3'K* local to the heart rate of the elderly women. At the end of research, blood pressure and heart rate were compared before and after the treatment. At the end of the study there were no significant treatment side effects. There were improvements in aging syndrome such as: anxiety to depression, insomnia, overactive bladder (especially at night), neuralgia, and myalgia. In treatment group was found decrease in sistolic (176 to 152 mmHg) and diastolic blood pressure (90 to 83 mmHg) ($p < 0.05$) without any changing in heart rate (81.68 to 79.32 b/sec) ($p > 0.05$). The conclusion of this research is giving 3 grams of fermented rice *M. purpureus JmbA3'K* every evening meal for fourteen days decrease the sistolic and diastolic blood pressure of the elderly without any changing in heart rate.

Keywords: Blood pressure, fermented rice, gamma-aminobutyric acid (GABA), heart rate, *Monascus purpureus*

Efek Pemberian Beras Fermentasi *Monascus purpureus* *JmbA3'K* terhadap Tekanan Darah dan Frekuensi Nadi Usila Wanita

Abstrak

Peningkatan angka kejadian hipertensi sangat pesat, pada tahun 2000 lebih dari 25% populasi dunia penderita hipertensi yang diperkirakan pada tahun 2025 meningkat menjadi 29%. Angka kejadian hipertensi khususnya pada wanita akan meningkat pada usia posmenopause (usila) sehingga perlu diupayakan pencegahan hipertensi pada wanita usila, khususnya pemberian makanan yang mempunyai efek menurunkan tekanan darah. *Gamma-aminobutyric acid* (GABA) mempunyai sifat menurunkan tekanan darah melalui pengaturan tonasi otot polos pembuluh darah terkandung pada biji-bijian yang ditumbuhi kapang *Monascus purpureus* sp. Penelitian ini merupakan penelitian *case control* yang dilakukan Juni 2013 terhadap 19 orang subjek wanita usila rentang usia 60–80 tahun penghuni Panti Wreda Santana, Cirebon untuk mengetahui efek pemberian beras fermentasi *M. purpureus JmbA3'K* terhadap tekanan darah dan frekuensi nadi. Subjek diberikan 3 g beras fermentasi *M. purpureus JmbA3'K* selama 14 hari. Tekanan darah dan frekuensi detak jantung dimonitor setiap hari. Pada akhir penelitian tekanan darah dan frekuensi nadi dibandingkan antara sebelum dan sesudah perlakuan. Uji beda Wilcoxon untuk melihat apakah efek pemberian beras fermentasi dari kapang *M. purpureus JmbA3'K* lokal terhadap tekanan darah sistole dan diastole usila dan uji beda rata-rata menggunakan *paired t test* dilakukan untuk melihat apakah efek pemberian beras fermentasi dari kapang *M. purpureus JmbA3'K* lokal terhadap frekuensi nadi usila. Pada akhir penelitian tidak didapatkan efek samping perlakuan yang berarti. Didapatkan perbaikan sindrom penuaan seperti ansietas sampai depresi, insomnia, *overactive bladder* (terutama malam hari), neuralgia, dan mialgia. Terdapat perbedaan tekanan darah sistole dengan diastole sebelum (176/90 mmHg) dengan sesudah diberi perlakuan (152/83 mmHg) ($p < 0,05$) tanpa perbedaan frekuensi nadi sebelum (81,68 kali/menit) dengan sesudah diberi perlakuan (79,32 kali/menit) ($p > 0,05$). Simpulan, pemberian beras IR-42 fermentasi *M. purpureus JmbA3'K* menurunkan tekanan darah sistole dan diastole usila tanpa perubahan frekuensi nadi.

Kata kunci: Beras fermentasi, frekuensi nadi, *gamma-aminobutyric acid* (GABA), *Monascus purpureus*, tekanan darah

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Introduction

According to the National Institute of Health Research and Development (NIHRD), Ministry of Health of the Republic Indonesia in year the 2000, the Indonesian population is currently the fifth largest in the world with a population shift pyramid in Indonesia. Economic progress and health degrees cause life expectancy to increase from 60–62 years to 66 years.¹

According to the results of *Survei Kesehatan Rumah Tangga Indonesia* (SKRT) (Indonesian Household Health Survey), cardiovascular disease (CVD) is increasing and is the main cause of death as much as 16% (SKRT 1992), 1995 as much as 18.9%, and in 2001 reached 26.9%.² According to *Riset Kesehatan Dasar* (Riskesmas) (Basic Health Research) in the year 2007 the prevalence of heart disease in Indonesia reached 7.2% (diagnosed and with symptoms), whereas deaths caused by ischemic heart disease 5.1%, stroke 15.4%, and other heart disease 4.6%.²

The incidence of hypertension is increasing rapidly, recorded in the year 2000, more than 25% (about 1 billion people) of the world's population is hypertensive, and two-thirds of people with hypertension is in developing countries. If we not done any right effort, this number will continue to increase, and by the year 2025 the number of hypertension patients is predicted to 29%, or about 1.6 billion people worldwide.³

The majority of CVD problems are caused by hypertension, whereas to date hypertension remains a major challenge in Indonesia, the prevalence of hypertension is 25.8%.⁴ In addition, hypertension control is inadequate even though effective drugs are widely available.

Women are more protected from cardiovascular disease due to hormonal effects, therefore the incidence of cardiovascular disease increases in the postmenopausal period.^{5,6} This is caused by a drastic decrease in sex hormones, especially estrogen, which maintains smooth muscle tone smoothness of blood vessels.⁷

Regulation of vascular sympathetic tone is influenced by the hypothalamic paraventricular (PVN) nucleus. Impaired control of GABAergic PVN neurons contributes to an increase in sympathetic muscle tone sympathetic blood vessels leading to hypertension.⁸ Arrangements and administration of gamma-aminobutyric acid (GABA) foods should be sought in order to protect elderly women from hypertension.

Gamma-aminobutyric acid or GABA is a

compound that has the nature of lowering blood pressure through regulation of smooth muscle tone of blood vessel especially vein.⁸ Grain covered with mold *Monascus purpureus* sp. can produce GABA.^{9–11} GABA administration to patients with mild hypertension can lower blood pressure.^{12–15}

This study aimed to measure the effect of fermented rice from local *M. purpureus* *JmbA3'K* to blood pressure level of systolic/diastolic and pulse frequency in elderly women.

Methods

Materials which used in this study are *Monascus purpureus* *JmbA3'K* microorganisms from the collections of the Biology Laboratory of the Center for Biological Research-LIPI, Cibinong Science Center and IR-42 low quality rice, from the Bogor market in January 2013.

The subjects of this study were elderly women (60–80 years old) of the Santana Nursing Home, Cirebon. Prior to the study, adaptation was performed with standard daily feeding (55% carbohydrate, 20% protein, 25% fat) without drinking water restriction during adaptation (seven days).

The inclusion criteria of this study were healthy elderly women, aged 60–80 years. Exclusion will performed if anorexia and liver, kidney, or other health problems occurs during the treatment period.

The sample size can be determined based on the formula of unpaired numerical analytical samples, 17 required 17 people, to keep the high representative level in case of drop out, we add the number of samples to 19 people.

Before blood sampling, homogenization of food input was performed at least 7 days before treatment with feed intake of 55% carbohydrate, 20% protein, and 25% fat. In the evening before sampling, the subject was fasted for 12 hours. The morning after in a state of fasting (allowed to drink enough water) the blood was taken by means of a puncture vein in the right brachial vein.

Blood pressure checking was done every day, at 7:30 am, at the right arm position with blood pressure measuring device Omron HEM 907. Before subject examination was rested from activity for 15 minutes.

The GABA dose used for hypertension ranges from 10 mg per day,^{14,15} referring the dose of GABA, fermented rice powder of *M. purpureus*

Table 1 Normality Test of Variables Measured on Study

Variable	Normality Test	
	p Value	Data Distribution
Systolic blood pressure before treatment	0.978	Normal
Systolic blood pressure after treatment	0.040	Abnormal
Diastolic blood pressure before treatment	0.046	Abnormal
Diastolic blood pressure after treatment	0.206	Normal
Heart rate before treatment	0.130	Normal
Heart rate after treatment	0.150	Normal

Shapiro Wilk normality test

sp. given as much as 3 g,¹⁶ after dinner mixed and stirred in 200 mL reverse osmosis water {Advance P-5200R (APIT-003)} was boiled at 100°C for 3 min, then cooled.

During the treatment, the subjects continued to be fed similar foods to the carbohydrate composition of 55%, 25% fat and 20% protein.

Prior to statistical analysis, for numerical data type, normality test is done by using Shapiro-Wilk test to see the distribution of data whether the data is normal distribution or not, the result of normality test can be explained in Table 1.

Shapiro Wilk normality test showed that for heart rate variables in normal distribution ($p > 0.05$) so that the data were analyzed using parametric tests. The variables of systolic and diastolic blood pressure were not normally distributed ($p < 0.05$) so the data were analyzed using non-parametric tests.

Wilcoxon signed-rank test was conducted

to see whether the effect of local *M. purpureus JmbA3'K* fermented rice administration on systolic and diastolic elderly blood pressure. The average difference test used paired t test to see whether the effect of fermented rice is given by the local *M. purpureus JmbA3'K* mold to the elderly pulse frequency. This test was conducted to see whether there was or not a significant effect of GABA content in IR-42 fermented rice with *M. purpureus JmbA3'K* on heart rate of elderly.

Results

Based on the calculation, both of systolic and diastolic blood pressure obtained p value < 0.05 (Table 2). Therefore, it can be concluded that there was a difference in blood pressure of systolic and diastolic before and after treatment.

Based on the calculation results obtained p value > 0.05 , there was no difference in pulse

Table 2 Comparison of Systolic and Diastolic Blood Pressure Before the Treatment

Sistolic and Diastolic		n	Median	Range	Zwx	p
Sistolic	Before	19	176	118–217	-3.283	0.001
	After	19	152	121–206		
Diastolic	Before	19	90	62–138	-3.137	0.001
	After	19	83	60–94		

Table 3 Comparison of Pulse Frequency Before with Treatment

Heart Rate	Median	t Count	df	t Table	p
Before	81.684	1.513	18	1.73	0.074
After	79.316				

frequency before and after treatment (Table 3).

Discussion

From the nineteen subjects, there were no significant side effects of treatment (rhabdomyolysis and impaired liver and kidney function). A small side effect that occurs is a complain of headache after treatment so it is overcome by gradual administration (50 mL per 15 min).

The result of the prehistory and the post treatment in this study found another improvement in the complaints of the research subjects. As is known in the elderly almost get aging syndrome such as anxiety to depression, insomnia, overactive bladder (especially the night), neuralgia, and myalgia. In the treatment group, the symptoms of aging are almost completely reduced. Lydiard¹⁸ states this may be caused by GABA having an antianxiety effect. GABA is the main transmitter inhibitor in the central nervous system (CNS). A balance between GABA and glutamate transmitter inhibitors in the CNS that maintains anxiety levels. GABA proven to reduce anxiety.

At baseline examination, almost all subjects (median systolic blood pressure 176 mmHg and diastolic blood pressure 90 mmHg) suffered from class II hypertension (JNC 7, 2003).¹⁹ This is consistent with research conducted by Lima et al.,⁵ Maas & Franke,⁶ and Yanes & Reckelhoff⁷ which states that hypertension often occurs in the postmenopausal period. Several studies have shown that changes in the ratio of estrogens to androgens support the increase of androgens, activation of the renin-angiotensin system and endothelin, activation of the sympathetic nervous system, metabolic syndrome and obesity, inflammation, increased eicosanoid vasoconstrictor, and anxiety and depression are important factors in the pathogenesis of postmenopausal hypertension. This causes hypertension to be difficult to control in elderly women than in elderly men.⁵⁻⁷ GABA provision is proven to prevent anxiety and smooth muscle tone of blood vessels through inhibition of sympathetic nervous activity.

After fourteen days observation on the subjects, it was found out that the administration of *Monascus purpureus JmbA3'K* fermented rice, could decrease systolic ($p=0.001$) and diastolic ($p=0.001$) blood pressure without interruption to heart rate. Research conducted by Li and Pan⁸

and Shimada et al.¹² used chlorella containing GABA in patients with mild hypertension and borderline proven to lower blood pressure. Hypothalamic paraventricular nucleus (PVN) is involved in regulation of smooth muscle tonics. Disorders of GABAergic control of PVN neurons can contribute to the sympathetic drive that increases blood smooth muscle tone in hypertension. GABA proved to decrease the smooth muscle tone of blood vessel that occurs in hypertension.^{8,12} The difference in this study was used 3 grams of fermented rice *Monascus purpureus JmbA3'K*, collection from the LIPI Cibinong Research Center, which contains enough GABA to lower blood in elderly women.

Nonetheless, this study has several susceptibility, which are the subject was elderly women that have experienced a decline in cleansing of nutrients or drugs taken, metabolism, and homeostasis that are different from young adults. For further research can be done on young adults and also in men. Another disadvantage is the taste of the *Monascus purpureus JmbA3'K* fermented rice solution which is less tasty so that cause the level of compliance in this study decreased. Higher doses of divided doses may be given for further research to find the optimal dose.

Suggestions for further research are necessary measurements that still need to be done to determine the optimal dose needed and can be used in long-term use.

Conclusion

The results of this study that has been described, it is concluded that giving IR-42 rice fermentation *Monascus purpureus JmbA3'K* at 3,000 milligrams once a day for 14 days can lower systolic and diastolic blood pressure without changes in heart rate.

Conflict of Interest

The authors declare no conflict of interests.

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