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1 Introduction

Since time immemorial, obesity has engulfed the mankind. It's a pandemic. The prevalence is increasing by leaps and bound (Jha &Dap, 2019). Obesity is a highly prevalent health condition associated with increased morbidity and mortality (Abdeelal et al., 2017). Based on the results of primary health research in 2013, the prevalence of obesity in Indonesia has increased significantly. The prevalence of obesity and central obesity in the Indonesian adult population are 23.1% and 28%, respectively (Harbuwono et al., 2018). Obese children and adults have high daily energy expenditure because the resting metabolic rate (RMR) in obese individuals is higher than in non-obese individuals (Rimbach et al., 2022).

RMR reflects the energy expended by the human body in a prolonged resting state in the absence of food digestion, physical or cognitive activities. RMR is affected by changes in body size, with greater RMR associated with larger body size, especially large lean body mass. RMR is widely determined by the most metabolically active tissues, such as muscle, heart, brain, and liver (Zampino et al., 2020). RMR is the most significant component of total energy expenditure (TEE). RMR has a substantial role in regulating the sensation of hunger and the daily energy intake needed to maintain physiological functions and the body's energy balance (Hopkins & Blundell, 2017).

Early adulthood is a period of rapid personal development when individuals experience major life transitions (e.g. leaving the parental home, leaving education, beginning employment, cohabitation and parenthood). Changes in social and physical environments associated with these transitions may influence development of health-related behaviours (Winpenny et al., 2020).

Maintaining body energy balance can be done by controlling appetite and the urge to eat. In the last 10 years, it has been well documented that energy expenditure is a major driver of energy intake. Although the major energy demand is generated by resting metabolic rate (RMR), activity energy expenditure also exerts a positive but weaker effect, and daily physical activity is associated with daily food intake (Beaulieu et al, 2021). The decrease in RMR can occur by increasing the efficiency of mitochondrial respiration. Nitric oxide (NO) is a substance that can perform this role. The increase in NO in the body can be triggered by an increase in inorganic nitrate, which can be obtained through the consumption of green leafy vegetables and fruits rich in nitrate (Carriker et al., 2019).

Sources of inorganic nitrate are found in many green fruits and vegetables. In the case of fruits, it was observed that the mean nitrate concentration of banana scored the highest (200 mg/kg), whereas other three fruits viz., apple, grape, and orange scored below 20 mg/kg (Uddin et al., 2021). Ambon banana (*Musa acuminata cola*) is one of the banana varieties that can be used as a source of inorganic nitrate. Based on the size, Ambon bananas have the largest size, 16-20 cm, compared to other varieties such as Berlin bananas and Kepok bananas, which are less than 15 cm in length. In addition, Ambon banana has better antioxidant activity than vegetables. One of the main antioxidant components found in Ambon banana is sinapic acid, where sinapic acid is an antioxidant that works effectively on peroxynitrite radicals, which are free radicals resulting from the reaction between NO and superoxide (O^{2-}) (Wahjuningrum, 2022). Other bioactive compounds in Ambon banana bay are biogenic amine groups, including dopamine, serotonin, and norepinephrine (Netshiheni et al., 2019). Serotonin can reduce oxygen consumption in the periphery, and serotonin also reduces energy expenditure (Yabut et al., 2019). The content of inorganic nitrate, which is quite significant in Ambon bananas compared to other bananas, will increase NO levels in the body to reduce RMR. Besides, the serotonin content in Ambon bananas can also reduce RMR by reducing peripheral

oxygen consumption.

2 Methods

This research is an experimental study with a pre-test-post-test design. The research was conducted for two weeks, starting on September 11 – 29, 2018, at the Physiology Laboratory of the University of Muhammadiyah Malang. This study used medical faculty students as respondents. The number of respondents involved in this study was 80, divided into two groups: the control group and the treatment group. The inclusion criteria of the respondents in this study include physically and mentally healthy (blood pressure obtained systolic 120-140 mmHg and diastolic blood pressure 80-100 mmHg. Pulse 60-100 times per minute), BMI 20.3-28 and Age 18-22 year. Exclusion criteria in this study included smokers and vegetarians who consume low-protein, high-carbohydrate foods, including bread, wheat porridge, dry peas, beans, rice, pasta, noodles, and vegetables, and have a history of chronic diseases, in a period of weight loss by reducing the number of calories and living in an industrial area.

Pre-experimental RMR measurements were carried out before the intervention with the Ambon banana diet. Measurement of RMR using an indirect calorimeter (Harvard). After the intervention with the Ambon Banana diet for six days, on the seventh day, the post-experimental RMR measurements were carried out.

The treatment group in this study was given the Ambon banana diet intervention in as many as four pieces, with each fruit having a mass of 118±5 grams daily for six days. Meanwhile, the treatment group did the usual diet without adding the Ambon banana diet. For six days, the respondents had to limit the consumption of other sources of inorganic nitrate vegetables such as cabbage, spinach, red beets, celery, watercress, and radishes and limit the consumption of nuts such as cashews, peanuts, walnuts, almonds, and candlenuts.

Data analysis used in this study included the Kolmogorov-Smirnov normality test, unpaired t-test and paired t-test.

3 Results

Based on the results of the Kolmogorov-Smirnov normality test, the P value <0.05 means that the distribution of the research data is not normal. Furthermore, a non-parametric test was carried out for unpaired t and paired t.

The result of the non-parametric t-test of unpaired Mann-Whitney for pre-experimental RMR data is P = 0.312, meaning there was no difference in RMR between the control and treatment groups before the intervention.

The nonparametric Wilcoxon paired t-test showed that the P-value in the control group with normal BMI was 0.326 and overweight BMI was 0.715, meaning that there was no difference between pre-experimental and post-experimental RMR. Meanwhile, for the treatment group, it was found that respondents with normal BMI had a P-value = 0.009 while respondents with overweight BMI had a P-value = 0.028; the interpretation of the P-value was that in the treatment group, both respondents with normal BMI and overweight there was a difference between RMR pre-experimental and post-experimental. Judging from the data presented in table 5.1, it can be seen that the decrease in RMR in the treatment group showed significant result.

4 Discussion

This study has proven that the Ambon banana diet (*Musa acuminata cola*) can reduce the resting metabolic rate (RMR) of medical students of University of Muhammadiyah Malang with normal BMI (P = 0.009) and overweight (P = 0.028). RMR is the minimum energy the body requires to perform its basic functions. RMR is the most significant part of total energy expenditure (TEE), where TEE is the total amount of energy required for daily activities (Woods et al., 2018). A decrease in RMR can reduce

appetite and the urge to eat so that the caloric intake is lower and maintains a feeling of fullness for longer (Hopkins & Blundell, 2017). In this study, the Ambon banana (*Musa acuminata cola*) diet was carried out for six days; every day, the research subjects consumed 4 Ambon bananas (*Musa acuminata cola*), with each fruit weighing 118 ± 5 grams.

Ambon banana (*Musa acuminata cola*) diet can increase nitrate levels in the body; this is because Ambon banana has a high inorganic nitrate NO^{3-} content of 4.5 mg/100 g (Wahjuningrum et al, 2022). Nitric oxide (NO) is a pluripotent signaling molecule produced by almost every organism and utilized in over 46 different physiological functions, especially within the cardiovascular system. NO^{2-} is reduced to NO through an acidification process or reactions with several reducing proteins, including hemoglobin, enzymes containing molybdenum, NOS, and electron transport chain components (Massa, 2021).

NO has an essential role in regulating mitochondrial respiration by downregulating mitochondrial proteins involved in uncoupling (Adenine nucleotide translocator and uncoupling protein 3). In addition to lowering the regulation of proteins involved in the uncoupling process, the NO formed will also react with superoxide to form peroxy-nitrite compounds which will inhibit cytochrome C-oxidase so that O_2 cannot bind (Poderoso et al., 2019).

In addition to inorganic nitrate content, Ambon bananas contain other ingredients that affect the reduction in RMR, namely biogenic amines. The biogenic amines in bananas include dopamine, serotonin, and norepinephrine. Serotonin levels in bananas are 8 - 50 g/g (mean 28 g/g) (Fatchurohmah, 2019). Serotonin reduces oxygen consumption in the periphery because serotonin can be a vasoconstrictor agent (Herr et al., 2017).

5 Conclusion

Ambon Banana Diet (*Musa acuminata cola*) has an effect on decreasing resting metabolic rate (RMR) on young adults. Further research needs to compare the influence of the Ambon banana (*Musa acuminata cola*) diet on respondents with normal BMI, overweight and obese. Further research is needed on the effect of differences in the duration (acute/chronic) of the Ambon banana (*Musa acuminata cola*) diet and the amount of fruit consumed in one day on RMR.

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