Early Detection of Hungry Sensation for Efficiency of Healthy Food Preparation

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Keywords: hungry sensation, hunger feeling, early detection of hungry sensation.

Abstract: Job pressures often make people not feel hungry even though the physical condition is actually hungry. This problem makes scheduling meals times very needed, that is why early detection of hunger is needed. Metabolism in the human body is shown by the reaction between glucose and oxygen. The reaction produces carbon dioxide gas, water, and energy. Carbon dioxide coming out of the human breath is taken as a sample and immediately reacted with pure water. This reaction will increase the acidity of pure water. The higher the CO_2 content thas is included, the higher the acidity of the water. High CO_2 from the breath indicates that the metabolic rate is high. On the contrary, the high CO_2 is indicated by the low pH value. Therefore, when pH is at that peak, it shows that the metabolic rate is at its lowest. Achieving the lowest point of metabolic rate becomes an indicator that that's where humans begin to feel hungry. Research found that the highest point of pH was reached at 90th minute after eating (predictions from the 90th minute to the 120th minute). Than we conclude that that the starting point of hunger was detected in the 90th minute after meals.

1 INTRODUCTION

Preparing food for the people needs to be done with the right time so that when the food is ready to be served, the person who wants to consume is also right to be hungry. sick due to late eating. Problems that occur in society are the time points of ripe food often not at the same time as the starting point of hunger, due to the ignorance of the food preparation about when the consumer starts to get hungry. The event will waste food preparation management funds. The risk of inefficiency can be minimized using early detection of hunger.

The problem of this research is that human speed metabolizes nutrients starting from digesting food, absorbing, and utilizing nutrients varying from one another. The average and standard deviation of metabolic rate needs to be measured between a group of the same age and sex. Nutritional metabolism in a nutshell is a reaction: $C_6H_{12}O_6 + 6 O_2 \rightarrow 6 CO_2 + 6 H_2O$ + 675 kcal of energy as written by Winarno (1995). The speed of nutritional metabolism occurs in a fluctuating manner, when the supply of glucosate is high, the reaction tends to be fast, otherwise it is low in glucose, the reaction slows down. The rate of metabolism after meals, if associated with increasing time, will form a chart from low, rise to the top, reach the top, and begin to decline. The chart pattern that is formed (Fig. 1.) can be used to predict when a person starts to get hungry again.

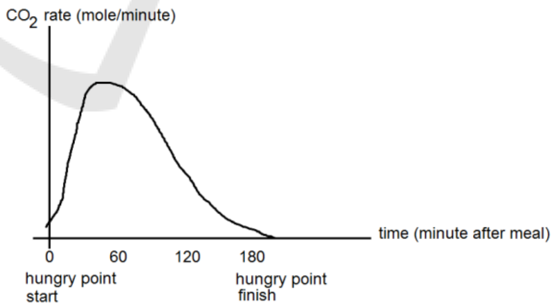

Figure 1: Theoritical correlation between time and CO_2 rate.

Therefore this research will answer the problem: 1. How is the pattern of nutritional metabolism rate (equivalent to CO_2 production of mole / minute / kg of body weight) along with the increase in time after eating (post feeding). 2. Is there a real correlation between high / low metabolic rate and feeling of fullness / hunger.

Triatma, B., Widayani, S., Iktarastiwi, N., Astuti, F. and Sari, T.
Early Detection of Hungry Sensation for Efficiency of Healthy Food Preparation.
DOI: 10.5220/0009012404210424
In *Proceedings of the 7th Engineering International Conference on Education, Concept and Application on Green Technology (EIC 2018)*, pages 421-424
ISBN: 978-989-758-411-4

2 PURPOSE AND CONTRIBUTION

The study aims to: 1. Get a picture of the rate of nutritional metabolism as time increases after eating, 2. Testing is there an associative relationship between high / low metabolic rate and feeling of fullness / hunger.

Research contribution is create an associative relationship between high / low metabolic rate and feeling of fullness / hunger, and how the trend changes over time, then this study becomes the basis for finding early hunger detection devices based on one's breath, which CO_2 can be absorbed using in the breath. special paper that has been moistened with $Ca(OH)_2$, the decrease in pH that occurs can be converted into digital form containing predictions about how many more minutes a person will begin to get hungry again.

3 LITERATURE

Metabolism is a series of solutions (analysis) and the re-establishment (synthesis) of nutrients in the human body. Analysis reactions break down glucose molecules into water and carbon dioxide gas as follows:
$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$ which also produces energy of 675 kcal per mole of $C_6H_{12}O_6$. This energy is then stored in the form of chemical bonds between Adenine (A) and phosphate (P) groups to form Adenine mono phosphate (AMP). Next E + P + AMP -> ADP (Adenosine in Phosphate). Next E + P + ADP -> ATP (Adenosine Tri Phosphate). When energy is reused, ATP is broken down again into ADP + P + energy, and so on ADP -> AMP + P, then AMP -> A + P + energy. The biochemical changes occur in the body cells, while the changes have an impact on the body is the production of CO2 and H2O gas which is discharged through the airways (Williams and Caliendo, 1984). Measurement of nutritional substance during metabolism according to Whitney and Rolfes (2006) consist of synthesis and analysis reaction occured in the body. The synthesis is for example glucose + glucose + energy into glycogen. There is also the synthesis of triglycerides from glycerol + fatty acids + energy. Other syntheses such as amino acids + amino acids + energy into proteins Analysis reaction is the opposite of synthesis. Both reactions are called metabolism, which requires energy equilibrium. Energy in body cells is produced in components called mitochondria which are kitchen energy. When the body is over-energized, the excess is stored in the liver in the form of glycogen and partly as fat tissue under the skin. Excess protein will be removed in the form of urine through urine. When 2-3 hours after eating, the body becomes deficient in energy, the body breaks down stored glycogen in the liver and fat under the skin, burns it into energy. As an excess of burning glycogen, CO_2 and H_2O are released through the airways. Production rate CO_2 per minute per kg of body weight is an indicator of the speed of nutritional metabolism. The amount of CO_2 can be determined by capturing it using lime water solution of $Ca(OH)_2$ by reaction: $CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$.

Under conditions of severe energy shortage, which is 24 hours after energy starvation, the body begins to break down proteins into amino acids to get energy for the activities of the brain and central nervous system. Whitney and Rolfes (2006) also say that when hungry, the body slows energy use and fat loss. Hunger conditions also trigger slowing of heart rate, respiration rate, and slowing down the rate of metabolism. So at the time after the last meal (post feeding) the metabolic rate will be slower. Measurement of the rate of metabolic deceleration has the potential to be one indicator of hunger. In conditions of hunger, body temperature also decreases, in addition to less sharp vision.
Center for Sense of Loneliness / Hungry.

Stark, Reichenbach, and Andrews (2015) say that homeostatic maintenance of energy requires integration with a component in the center of the brain, called hypothalamic. Hypotalamic is responsible for receiving feedback when the body lacks glucose, amino acids, and metabolic hormones such as insulin, leptin and ghrelin. So hypothalamic receives information if the body is starting to starve for energy sources. Hypothalamic ability to maintain energy balance is due to carnitine metabolism. Thanks to this hypothalamic ability, the body can receive messages when the body is full or hungry.

4 METHOD

The research was conducted between September 2017 until September 2018, located in the Home Economic Department under Technical Faculty (TF), Semarang State University (SSU). This study took humans (Home Economic students of TF-SSU) as sample volunteers. The form of research is a quasi experiment, while the data taken in the form of breathing CO_2 production rate after 0 minutes, 60 minutes, 120 minutes and 180 minutes since eating equal 300 kcal. Volunteers who were taken as many as 16 people aged 20 years were female, with the same nutritional status (body mass index). Data was taken by: volunteers were asked to exhale for 3 seconds at a specified time, hold it in an airtight plastic wrapper. The CO_2 content is then measured by dissolving it into a solution of Ca $(OH)_2$ 0.5 Molarity in order to form the precipitating $CaCO_3$ salt, as presented below: CO2 + Ca $(OH)_2 \rightarrow CaCO_3 + H_2O$, then the remaining Ca $(OH)_2$ titrated using HCl to find out the amount of Ca $(OH)_2$ remaining. The data is then presented in graphical form as Fig. 1.

The data were then analyzed for changes from the 0^{th} minute, 60^{th} minute, 120^{th} and 180^{th} minutes. The chart formed is an illustration of the rate of nutritional metabolism as time increases after meals. Volunteers were also asked to feel hungry / not at the same time as CO_2 breath measurements. The frequency of occurrence of hunger and high and low levels of CO_2 breath is a test of the presence / absence of associative relationships between metabolic rate and feeling of fullness / hunger. The analysis is carried out by contingency testing.

5 RESULT AND DISCUSSION

The study produced the data shown in Table 1.

Table 1: Mean and standard deviation of breathe solution pH.

Time (minute before/after) meal	Mean and standard deviation	Number of samples
0 before	6.67 ± 0.12	12
0 after	6.46 ± 0.25	12
60 after	6.55 ± 0.28	12
120 after	6.55 ± 0.21	12
180 after	6.40 ± 0.29	12

The pH of pure water is 7.0. If the exhaust air is blown into pure water from the breath, then CO_2 from the breath will compound with H_2O, thus forming H_2CO_3 carbonic acid. Then H_2CO_3 gives an acidic atmosphere because it easily breaks down into two H^+ ions and one CO_3^{2-} ion. This additional H^+ ion will decrease the pH value from 7.0 to the scale below it. Decreasing the pH value indicates an increase in the level of H^+ ions in the system. The correlation between time and pH provided in Fig. 2.

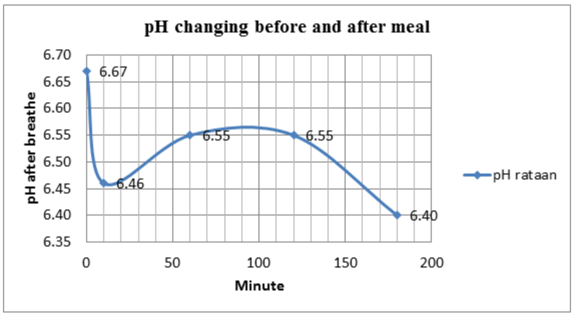

Figure 2: Real correlation between time and pH of breathe solution.

At 0 seconds before eating up to 0 seconds after eating an increase in H + ions is 1.33 x 10 -7 mole / liter from an initial level of 2.14 x 10 -7 mole / liter increasing to 3.47 x 10 -7 mole / liter . The incident occurred in the 10-minute meal period. From the 0th second after eating to the 60th second after eating, a decrease in H + ion levels was 6.45 x 10-7 mole / liter, from 3.47 x 10 -7 mole / liter to 2.82 x 10-7 mole / liter. Then from the 60th minute to the 120th minute there was no change in the level of H + ions, which remained at 2.82 x 10 -7 mole / liter. At this stagnant phase, a hungry point is reached. From the 120th minute to the 180th there was another increase in the H + ion level of 1.16 x 10 -7 mole / liter, which is from the beginning of 2.82 x 10 -7 mole / liter, rising to 3.98 x 10 -7 mole /liter.

The real pH of pure water before blowing the breath is standardized to neutral pH 7.0. Suppose the real pH = 7.3 then there is a correction number of (7.3 - 7.0) = 0.3. This figure of 0.3 is then used to correct the real pH of pure water after blowing the breath. For example, the real pH after blowing the breath = 6.4, then 6.4 minus 0.3 to 6.1 is the real corrected pH as shown in Table 2.The correlation between time and H^+ concentration of breathe solution provided in Fig. 3.

Table 2: Difference in the level of H+ ions after blowing for 6 seconds.

Time (minute after) meal	Mean and standard deviation	Number of samples
0	$(1.4 \pm 1.3) \times 10^{-7}$	12
60	$1.2\times10^{-7} \pm 9.2\times10^{-8}$	12
120	$1.0\times10^{-7} \pm 5.6\times10^{-8}$	12
180	$1.5\times10^{-7} \pm 9.3\times10^{-8}$	12

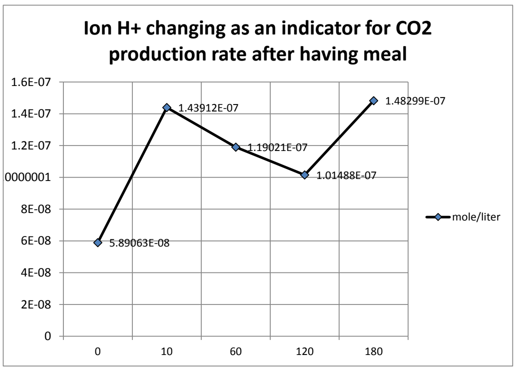

Figure 3: Real correlation between time and ion H^+ concentration of breathe solution.

6 CONCLUSION

It is suspected that the critical starting point is reached at 120 minutes after eating. There are close correlation between time after meal and metabolism rate of human.

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