Effect of Excessive Carrot Juice (*Daucus carota*) Administration on Uric Acid and Blood Glucose Levels in Rats (*Rattus norvegicus*)

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ABSTRACT

The consumption of carrot juice (*Daucus carota*) has been associated with various health benefits, yet its effects on metabolic parameters such as uric acid and blood glucose levels remain inadequately explored. Understanding these effects is crucial for developing dietary recommendations, particularly for conditions related to elevated uric acid and blood glucose. This research aimed to investigate the impact of excessive carrot juice administration on uric acid and blood glucose levels in rats (*Rattus norvegicus*). The study sought to determine whether carrot juice could serve as a beneficial dietary intervention or if it posed risks for metabolic dysregulation. A true experimental design was employed, utilizing a post-test only control group approach. Four healthy rats were divided into two groups: a control group receiving standard rat feed and a treatment group receiving carrot juice alongside their feed for seven days. Blood samples were collected after a 12-hour fasting period, and uric acid and blood glucose levels were measured using an Easy Touch GCU glucometer. Statistical analysis included descriptive statistics and T-tests to assess significant differences between groups. The results indicated that excessive administration of carrot juice significantly decreased uric acid levels in the treatment group compared to the control group ($p < 0.05$). Conversely, blood glucose levels were found to be significantly higher in the treatment group ($p < 0.05$), suggesting a complex interaction between carrot juice consumption and metabolic regulation. The study concludes that while excessive carrot juice can effectively lower uric acid levels in rats, it may also lead to increased blood glucose levels. These findings highlight the need for cautious dietary recommendations regarding carrot juice intake, particularly for individuals at risk of hyperglycemia. Future research should focus on larger sample sizes and explore the effects of carrot juice on various physiological systems and stress-related impacts on metabolic parameters.

Keywords: carrot juice, uric acid, glucose level, rats

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INTRODUCTION

Hyperuricemia and gout are increasingly common health conditions worldwide, with prevalence rising alongside changes in lifestyle and dietary patterns (Luk and Simkin, 2005; Smith et al., 2014). One approach to managing uric acid levels in the body is through the consumption of certain foods, including carrots (Safarina and Nursidika, 2021). Carrots (Daucus carota) are known not only as a nutritious vegetable but also for their diuretic properties and ability to aid in the excretion of uric acid through urine.

One of the primary benefits of carrots in the context of hyperuricemia is their ability to inhibit uric acid formation. The β-carotene in carrots can

influence purine metabolism, which is a precursor to uric acid (Kaneko et al., 2023). By converting xanthine, β-carotene helps reduce uric acid production in the body. Furthermore, the diuretic properties of carrots promote increased fluid excretion from the body, which can expedite the elimination of uric acid through urine (Kanbara et al., 2010; Li et al., 2023). This is important because nitrogen imbalance can contribute to elevated uric acid levels. By balancing nitrogen, carrots may potentially reduce the risk of gout attacks.

As a versatile and cheap food ingredient, carrots are consumed in various forms and are highly valued for its health-promoting properties (Rubatzky and Yamaguchi, 1997; Fadii, 2024). Carrots can be eaten raw as a snack, added to salads, or cooked in various dishes (Sharma et al., 2011). Apart from its benefits to reduce uric acid, carrots stand out because of their rich vitamin content, especially vitamin A, alongside other beneficial nutrients such as vitamins B1, C, and G (Sahar, 2020). Carrot juice is particularly notable for its antioxidant effects, often associated with the prevention of oxidative stress-related disorders.

However, excessive consumption of carrots can lead to elevated blood sugar levels (Stanhope, 2016). This can pose significant health risks, especially for individuals prone to metabolic disorders (Mouri and Badireddy, 2023). Studies have shown that high glucose intake can lead to insulin resistance, increased blood sugar levels, and, over time, can contribute to conditions like obesity and type 2 diabetes (Yari et al., 2019). In light of this, there is a growing need to understand how carrots influence metabolic health, especially concerning glucose regulation.

Glucose is a fundamental monosaccharide that plays a central role in energy production, particularly through aerobic and anaerobic respiration (Murray et al, 2014). In a healthy system, glucose is carefully regulated, as excess levels can disrupt normal metabolic processes (Simon and Wittmann, 2019). The breakdown of purines, another essential aspect of metabolism, produces uric acid as a by-product, which must be managed effectively to prevent complications like gout or kidney stones (Johnson et al., 2013). When glucose metabolism is impaired, such as in conditions of excessive intake, blood glucose levels may become dysregulated (McKee and McKee, 2015). These changes are often early indicators of metabolic dysfunction, which could lead to more severe health issues if left unchecked (Sautin and Johnson, 2008).

Experimental studies often employ animals as test subjects to model human health conditions. Among these, rats (*Rattus norvegicus*) are commonly used due to their physiological and metabolic similarities to humans (Sengupta, 2013). Their well-documented responses to dietary changes make them ideal subjects for studying glucose and uric acid metabolism (Sullivan, M., 2001. This research focuses on the effects of administering excessive amounts of carrot juice to rats, specifically observing changes in blood glucose and uric acid levels.

This study provides insights into the metabolic effects of excessive carrot juice administration and its potential to cause changes in uric acid and blood glucose levels. The findings can serve as a foundation for further research on the relationship between carrot diet and metabolic health, offering valuable data for nutrition science and dietary guidelines. From a practical standpoint, this research can inform future experimental designs and dietary

interventions targeting uric acid and blood glucose levels. The outcomes may have implications for developing dietary recommendations that help prevent metabolic disorders, especially in populations at risk of hyperuricemia, gout, diabetes or obesity. The study could also be useful for refining experimental protocols involving animal models of human metabolic diseases.

The research is based on the hypothesis that the excessive carrot juice administration will lead to the following metabolic changes in rats: a decrease in uric acid levels and an increase in blood glucose levels.

METHODS

This research utilizes a true experimental design, specifically a post-test only control group design. In this setup, rats will be divided into two distinct groups: one control group (P0) that will not receive any treatment and one treatment group (P1) that will be administered carrot juice over a period of seven days. This design allows for the clear observation of the effects of the treatment while minimizing biases that could arise from pre-existing differences between groups.

The subjects of this study will consist of four laboratory rats (*Rattus norvegicus*), aged between 8 to 12 weeks and weighing between 100 to 160 grams. These rats will be sourced from the Division of Veterinary Basic Medical Sciences at the Faculty of Veterinary Medicine, Universitas Airlangga. Ensuring that all subjects are in good health is crucial for the integrity of the experiment.

For this experiment, two groups will be formed, each comprising two rat samples. The rats will be labeled as one, two, three, and four for identification purposes. The assignment of the rats to either the control or treatment group will be executed using a random number generator to ensure unbiased selection. The control group (P0) will receive standard rat feed and aquades (distilled water), while the treatment group (P1) will be provided with carrot juice in addition to rat feed and aquades.

In this study, several variables are defined. Independent variable includes: the administration of carrot juice, quantified as 3 grams of carrot per 150 grams of body weight. Dependent variables include: the levels of uric acid and blood glucose measured through blood chemistry analysis. Control Variables include: Factors such as diet (provided ad libitum), access to water (also ad libitum), and housing conditions will be maintained constant throughout the study to avoid confounding results.

The research is scheduled to take place at the Kandang Hewan Coba and Veterinary Clinical Pathology Laboratory within the Faculty of Veterinary Medicine at Universitas Airlangga. The timeline for this study spans from October 21 to November 29, 2024.

The sample consists of four rats obtained through randomized sampling from the Division of Veterinary Basic Medical Sciences. Prior to experimentation, each rat underwent a physical examination, including body weight measurement. Following this assessment, the rats were acclimated to their laboratory environment for seven days, during which they were provided food and water ad libitum.

During the treatment phase lasting seven days, the treatment group (P1) received ten milliliters of freshly prepared carrot juice daily—equivalent to approximately three grams of carrot—based on their daily feed intake. The preparation involved washing, peeling, and chopping carrots before blending them with water to achieve a smooth consistency. In contrast, the control

group received only standard feed and water without any additional treatment.

To assess the impact of carrot juice on uric acid and blood glucose levels, blood samples were collected after fasting the rats for approximately 12 hours. The sedation process involved placing the rats in a chloroform tank before performing cardiac puncture for blood collection. The blood samples were then analyzed using an Easy Touch GCU glucometer specifically calibrated for glucose and uric acid measurements.

The materials required for this study include four rats (*Rattus norvegicus*), carrot juice made from 50 grams of carrots mixed with distilled water, standard rat feed, and aquadest. Essential equipment encompasses rat cages, feeding containers, syringes for administering treatments, an analytical balance for precise measurements, a juicer for preparing carrot juice, blood collection apparatuses, a chloroform tank for sedation purposes, and an Easy Touch GCU glucometer for conducting blood tests (Togashi et al, 2016).

The data collected from this experiment will undergo descriptive analysis to compare uric acid and blood glucose levels between the control and treatment groups. Statistical methods such as calculating means and standard deviations will be employed alongside T-tests to determine the significance of observed differences between groups.

RESULT AND DISCUSSION

All results in Table 1 and Table 2 were obtained from Easy Touch GCU glucometer test kit for uric acid and blood glucose levels. The data from the control group (P0) were compared to the uric acid and blood glucose levels in the treatment group (P1).

The results of uric acid and blood glucose levels in rats showed that there were statistically significant differences between the control group (P0) and treatment group (P1). The uric acid level is higher in the control group (P0) compared to the treatment group (P1), with the highest level of RAT 3 17,7 mg/dl and the lowest level of RAT 2 10,0 mg/dl. The blood glucose level is lower in the control group (P0) compared to the treatment group (P1), with the highest level of RAT 1 297 mg/dl and the lowest level of RAT 3 215 mg/dl.

From Table 1 and Figure 1, it can be seen that the control group (P0) has a uric acid level result of 16.85 ± 1.20 mg/dl compared to the treatment group (P1) which is 10.8 ± 1.13 mg/dl. The P-value of 0.04 shows that the comparison is statistically significant. From Table 2 and Figure 2, it can be seen that the control group (P0) has a blood glucose result of 222.5 ± 10.6 mg/dl compared to the treatment group (P1) which is 292 ± 7.07 mg/dl. The P-value of 0.02 shows that the comparison is statistically significant.

The data in Table 1 and Figure 1 shows that excessive carrot juice administration can decrease uric acid levels. The control group (P0) mean uric acid level result is 5.72 mg/dl more than the treatment group (P1). In the treatment group (P1), RAT 1 showed an uric acid level of 11.6 mg/dL, while RAT 2 showed a result of 10.0 mg/dL. Conversely, in the control group (P0), RAT 3 exhibited a higher result of 17.7 mg/dL, while RAT 4 showed a result of 10.0 mg/dL. The treatment group (P1) has an overall lower level of uric acid compared to the control group (P0).

This shows that carrots can potentially reduce uric acid levels in the blood due to their rich content of antioxidants, vitamins, and dietary fibre. The antioxidants found in carrots, such as β-carotene, play a significant role in combating oxidative stress, which is linked to inflammation and elevated uric acid levels (Adelina et al., 2016). By reducing oxidative stress, carrots may

help mitigate the risk of gout attacks and other conditions associated with hyperuricemia (Safarina and Nursidika, 2021). Additionally, the dietary fibre in carrots aids in the absorption and elimination of uric acid by binding it in the digestive tract and promoting its excretion through urine. This mechanism is particularly beneficial for individuals with high uric acid levels. Moreover, carrots have an alkalizing effect on the body, which helps neutralise excess acidity that often accompanies high uric acid levels. This balance can facilitate better kidney function and improve uric acid excretion (Kanbara et al., 2010).

Table 1. Result of uric acid level

Group	Rat Code	Result	Mean ± SD	P - Value
Control Group (P0)	RAT 3	17,7	16.85 ± 1.20	0.04
	RAT 4	16,0		
Treatment Group (P1)	RAT 1	11,6	10.8 ± 1.13	
	RAT 2	10,0		

SD: Standard Deviation; P-value of <0.05 shows that there is statistically significant difference between groups.

Table 2. Result of blood glucose level

Group	Rat Code	Result	Mean ± SD	P - Value
Control Group (P0)	RAT 3	215	222.5 ± 10.6	0.02
	RAT 4	230		
Treatment Group (P1)	RAT 1	297	292 ± 7.07	
	RAT 2	287		

SD: Standard Deviation; P-value of <0.05 shows that there is statistically significant difference between groups.

However, all uric acid levels of the rats are relatively high compared to the average uric acid level in rats, which is 2.93 to 5.03 mg/dl (Nuranjumi et al., 2022; Yun et al., 2017). The high levels of uric acid level may be caused by stressed conditions of the rats being handled, resulting in increased purine metabolism and reduced clearance, as supported by previous study of Priyanto et al. (2023).

The data in Table 2 and Figure 2 shows that excessive carrot juice administration can increase blood glucose levels. The control group (P0) mean blood glucose result is 69.5 mg/dl less than the treatment group (P1). In the treatment group (P1), RAT 1 showed a blood glucose level of 297 mg/dL, while RAT 2 showed a result of 287 mg/dL. Conversely, in the controlled group (P0), RAT 3 exhibited a lower result of 215 mg/dL, while RAT 4

showed a result of 230 mg/dL. The treatment group (P1) has an overall higher level of blood glucose compared to the control group (P0). This shows that the sugar content in carrot can increase blood glucose levels.

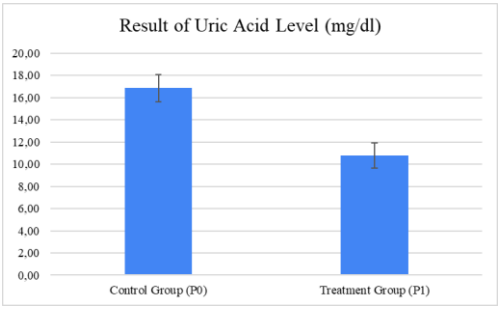

Figure 1. Mean and standard deviation of uric acid level result in control group (P0) and treatment group (P1).

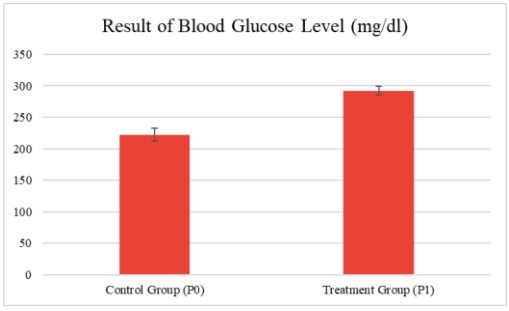

Figure 2. Mean and standard deviation of blood glucose level result in control group (P0) and treatment group (P1).

However, all blood glucose levels of the rats are relatively high compared to the average blood glucose level in rats, which is approximately 70 to 120 mg/dL (3.9 to 6.7 mmol/L) when fasting (Johnson et al., 2013; Sengupta, 2013). The high levels of blood glucose level may be caused by stressed conditions of the rats being handled (Vedantam et al., 2022). Stress can significantly impact blood glucose levels, primarily through the release of hormones that affect insulin sensitivity and glucose metabolism. When the body experiences stress, it triggers the 'fight-or-flight' response, leading to the release of hormones such as adrenaline (epinephrine) and cortisol (Sharma et al., 2022). These hormones prepare the body to respond to perceived threats by increasing blood sugar levels, ensuring that sufficient energy is available for immediate use.

During stressful situations, insulin levels typically decrease while glucagon and epinephrine levels rise (Sharma et al., 2022). This hormonal shift results in increased glucose production and release from the liver into the bloodstream. Additionally, cortisol can cause body tissues to become less sensitive to insulin, a condition known as insulin resistance. This means that even if insulin is present, it may not effectively facilitate the uptake of glucose into cells, leading to elevated blood sugar levels.

CONCLUSION

The findings of the experiment provide significant insights into the effects of carrot juice (*Daucus carota*) on the health parameters of rats (*Rattus norvegicus*). The results indicate that excessive administration of carrot juice can lead to a decrease in uric acid levels in these rats. This suggests that carrot juice may have a beneficial effect on uric acid metabolism, potentially offering a dietary intervention for conditions associated with elevated uric acid levels. Conversely, the same excessive intake of carrot juice was found to increase blood glucose levels in the rats. This dual effect highlights the complexity of dietary influences on metabolic processes and suggests that while carrot juice may aid in managing uric acid levels, it could also pose risks for blood glucose regulation.

In light of these findings, several recommendations for future research can be proposed. Firstly, increasing the sample size of rats in subsequent experiments would enhance the

reliability of the results and allow for a more robust statistical analysis. Additionally, further research could explore how carrot juice affects different changes in uric acid and blood glucose levels. Moreover, investigating the effects of stress on uric acid and blood glucose levels in rats presents another avenue for future studies. Stress is known to influence metabolic processes, and examining its interaction with dietary components like carrot juice could provide a more comprehensive understanding of how environmental factors affect health outcomes.

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Author Contribution

Muhammad Rafsa Al Thalhah: conceptualization, methodology. Chau Yu An: data curation, original draft preparation. Harvina Rajendaran: visualization, investigation. Nanik Hidayat, Arindita Niatazya Novianti: supervision. Jheevanesh Gunalan: software, validation. Bhagya Laxmi Ramesh Kumar: reviewing and editing.

Competing Interest

None.

Ethical Approval

The present study was approved by the Ethics Committee of Faculty of Veterinary Medicine, Universitas Airlangga.

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