International Journal of Health and Social Behavior
Volume. 1, No. 4, November 2024
e-ISSN : 3047-5325; dan p-ISSN : 3047-5244; Hal. 170-180
DOI: https://doi.org/10.62951/ijhsb.v1i4.181
Available online at: https://international.arikesi.or.id/index.php/IJHSB

Gender-Based Comparative Study Of The Influence Of Cola Nitida On Urine Calcium And Magnesium Concentrations Of Humans

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ABSTRACT : How *Cola nitida* could affect the urine calcium and magnesium concentrations of the male human subjects in comparison to the female counterpart were focused on. Sixty subjects (males=30 and females=30) and unaccustomed to Cola nut eating were involved. Their age range was between 18 and 28years. Three (3) sub-categories were involved: underweight=10, normal weight=10 and overweight=10. Hypertensive, renal and any subject with cardio-pulmonary-related conditions were exempted from the study. The normal chamber temperature, (RT=27^{0}C and RH=70%), the raised chamber temperature (RT =37^{0}C and RH=90%) were studied. Sequel to the foregoing, the subjects sat quietly in the sweat chamber for 20 minutes. The third experimental condition was the normal chamber temperature with exercise (RT=27^{0}C and RH=70%) and the subjects rode a bicycle ergometer at 750J/minute for 20 minutes. All of these happened prior to the consumption *Cola nitida*. Ahead of the experimentation in the sweat chamber, the subject urinated in a container in order for the timed urine volume to be measured and urine was again taken at the end of the experimentation that was also measured in order to obtain the actual urine volume within the given period. Thereafter, the urinary flow rate was calculated. The urine calcium and magnesium concentrations were likewise estimated. 0.5g/kg body weight of *Cola nitida* was given to each subject and chewed as a bolus. After swallowing, 50ml of deionized water was given to each subject to drink and the subject was allowed to rest for 90 minutes before being brought into the sweat chamber. The results showed that in respect to urine Ca ions concentration, no significant change was observed in a comparison between the males and females after the ingestion of *Cola nitida* under normal, raised temperature and exercise experimental conditions. As regards urine Mg ions concentration, no significant change was observed in a comparison between the males and females after the ingestion of *Cola nitida* under normal and exercise experimental conditions. However, there was a significant increase in Mg ions concentration in the female UW and NW subjects compared to the males after the consumption of *Cola nitida* under raised temperature condition.

Keywords: *Cola nitida*, urine calcium and magnesium concentrations, sweat chamber, exercise experimental conditions.

1. INTRODUCTION

Found in the blood and elsewhere, fluids and electrolytes, are crucial to the physiology of the body. Some factors like environmental and ill-health states might change their balance (Karalliedde *et al.*,2013). The fluids are ICF and ECF. Sodium ions are majorly found in the ECF whereas potassium ions are in the ICF (Wingfield, 2020).

Some investigators have observed that some factors such as temperature amongst others would determine heat production and the heat could be detrimental to the human body (Simon,

Received: Agustus 19, 2024; Revised: September 20, 2024; Accepted: Oktober 30, 2024;
Online Available: November 20, 2024;

1993). However, through the process thermoregulation, the body is still able to adjust. Too much heat could negatively impact the body fluids, the heart and blood vessels and the renal system (Semenza *et al*., 1999).

Workers such as those working in the bakeries could easily be impacted by much heat with resultant effects on the renal functions (Laux *et al*., 2011). Knowing that body mass index has a direct bearing to sweating pattern, the underweight, normal weight and overweight could therefore be subjects of interest regarding such a study (Kenchaiah *et al*., 2002). To keep fit, the place of exercise cannot be overemphasized (Thune and Lund, 1996); (Blair and Church, 2004). This is quite advisable as most individuals are beginning to adopt more of a sedentary lifestyle (Eaton and Eaton, 2003). A major essence of sweating is to remove heat from the body, especially when the environment is overheated. (Cheuvront *et al*., 2010).

During an exercise, body fluid might be lost which should be replaced subsequently for the avoidance of abnormality. In order not to aggravate a rather worse scenario already existing, the replacement fluid should be caffeine or alcohol free. It is a common knowledge that caffeine is a diuretic. The most active ingredient in *Cola nitida* is caffeine amongst others (McCarthy *et al*., 2008); (Umoren *et al*., 2009). It has been observed that a number of people are ignorantly abusing caffeine. Presently, the said substance is applicable in drink and drug production (Mednick *et al*., 2008).

Cola nitida is fondly consumed as a stimulant (Igwe *et al*., *2007) and* prior to this time, a gender-based comparative study involving the human subjects using the said Cola nut and under the aforesaid experimental conditions has not been done. Therefore, how *Cola nitida* influenced the sweat rate in all the three body weight was considered in this present study.

2. LITERATURE REVIEW

In order for human beings to survive in a given environment, the roles of the thermoregulatory system cannot be over-emphasized (Moran and Mendal, 2002).The thermoregulatory system interacts with body fluid regulatory and cardiovascular systems. The maintenance of body fluid status prevents progressive hyperthermia during exercise in a hot environment (Sawka and Montain, 2000).

Sweating is a thermoregulatory physiological adaptation associated with sweat gland function after heat exposure. The rate and sensitivity to sweating, increases with increasing environmental temperature (Libert *et al*., 1988; Armstrong and Maresh, 1991). Sweating serves both excretory and thermoregulatory roles, especially in humans (Ugwu, 2007).The sympathetic nervous system mainly regulates sweating (Stocking and Gubili, 2004).Sweat composition is mainly dependent on the fluid and electrolyte handling in the sweat glands (Ugwu, 1996; Shona *et al*., 2010).Water loss could be minimized going by the fact that it could be redistributed and this is dependent on the concentration and composition of the electrolytes (Sawka, 1988).

Thirst is a sensation of dryness of the throat associated with a craving for liquids, produced by deprivation of drink, or by some other cause which arrest the secretion of the pharyngeal mucous membrane; hence the condition producing this sensation (Obika *et al*., 2009)

3. MATERIALS AND METHODS

Subjects

Sixty (60) non-obese volunteers (30 males and 30 females and non-habitual Cola nut chewers, aged 18-28years were used for the study. Individuals from the University of Benin were used. Their health status was assessed with the aid of questionnaires and physical examination. All the subjects were active but none was athletically trained as defined by the absence of a regular physical exercise programme during the last six months before the experiment. They were divided into three (3) subgroups of underweight (n=10), normal weight (n=10) and overweight (n=10). Informed consent was obtained from each subject before the study and permission of the ethical committee of the university was also obtained.

Three environmental conditions were involved:

- The normal chamber temperature condition, with a room temperature (RT) of 27^0C and a relative humidity (RH) of 70%.
- The raised chamber temperature condition, with RT of 37^0C and RH of 90%.
- The normal chamber temperature with exercise condition, when RT and RH were maintained at 27^0C and 70% respectively.

The Sweat Chamber

Professor (Sir) A.C. Ugwu's Sweat Chamber (situated in the University of Benin) was used for the study. It is a room with the dimension 4m x 3m. A heater was used in raising the room temperature and a thermometer used in measuring it. An air conditioner was used to maintain the relative humidity while a hygrometer was used to measure it at the desired level. Prior to the studies, the subject's age (years), weight (kilogram), height (metre), blood pressure (mmHg), pulse rate (beats/minute) and timed urine volume (milliliter) were recorded.

Inclusion/Exclusion Criteria

Subjects with hypertension, kidney and heart-related conditions were excluded from the study. Knowing that the commonly accepted body mass indices (BMI) are: underweight (under 18.5 kg/m^2), normal weight (between 18.5-25.0 kg/m^2), overweight (between 25.0-30.0 kg/m^2) and obese (over 30.0 kg/m^2); only the subjects that were underweight, normal weight and overweight but not obese were so categorized and included in the study. Volunteers discontinued the experiment on reaching any one of the two criteria: 20 continuous minutes of exercise and voluntary cessation.

Each subject was studied on different days and studies commenced without breakfast. Before entering the sweat chamber, the subject was told to void the bladder in preparation for the timed urine volume measurement and immediately after the experiment in the sweat chamber, the subject also voided urine for measurement. The subject passed urine into a container which was in turn transferred into a measuring cylinder for measurement. Thirst perception rating was done immediately after the 20 minutes in the sweat chamber using the visual analogue scale (VAS).

There was a separate sheet of paper for each subject with a 10cm marking, the ends of which were marked "very thirsty" and "not thirsty". Subjects were first presented with instructions for completing the VAS. They then rated how thirsty they were by a mark across each scale.

0.5g/Kg body weight of *Cola nitida* which refers to a preliminary study in which the dose of *Cola nitida* taken in the study was worked out by allowing an ad-libitum intake until the subjects were satisfied. The range of the intake was between 0.39g/kg and 0.57g/kg body weight was administered to each subject to be chewed as a bolus. After ingestion, 50ml of deionized water was given to each volunteer to flush the masticated *Cola nitida* down the gut. The subject was allowed to rest for 90 minutes (preliminary experiments had suggested that the effects of the nuts were observable in body tissues 90 minutes after ingestion. Thereafter, the subject was admitted into the sweat chamber.

Estimation Of Urine Calcium And Magnesium

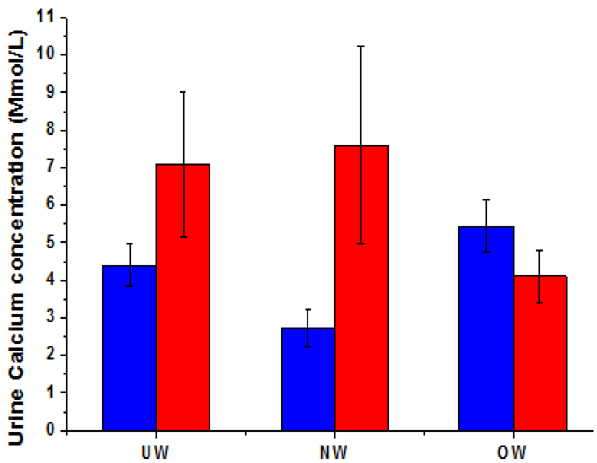
From the already measured timed urine volume, the urinary flow rate was calculated. The urine was also analysed for the respective electrolytes.

- **Calcium ion:** "Randox" Calcium reagent kit/Colorimetric method; for the quantitative in-vitro determination of Calcium in sweat.
- **Magnesium ion:** "Teco Diagnostics" Magnesium reagent kit; for the qualitative determination of Magnesium in sweat.

Data Analysis

All results were expressed by suitable tables and graphs as the Mean ± SEM. Statistical analyses were carried out using Analysis of Variance (ANOVA) in relation to Microcal Origin version 8.0 statistical software and the 0.05 level of probability ($P<0.05$) was regarded as significant.

4. RESULTS



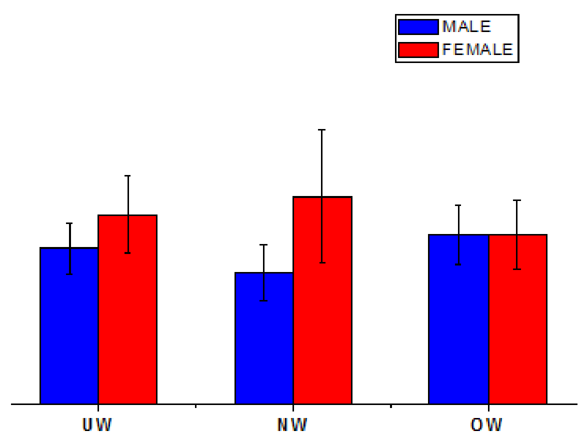
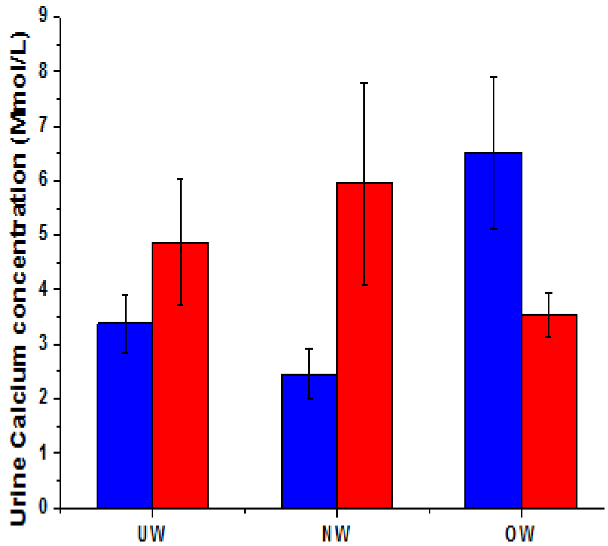


Diagram 1. BEFORE **Diagram 2. AFTER**

NORMAL CHAMBER TEMPERATURE(RT= 27^{0}C, RH= 70%) NORMAL CHAMBER TEMPERATURE(RT= 27^{0}C, RH= 70%)

FIG.I: SHOWING THE ***URINE CALCIUM CONCENTRATION*** IN INDIVIDUALS OF DIFFERENT BODY WEIGHT BEFORE AND AFTER INGESTING OF *COLA NITIDA* AT NORMAL CHAMBER TEMPERATURE.



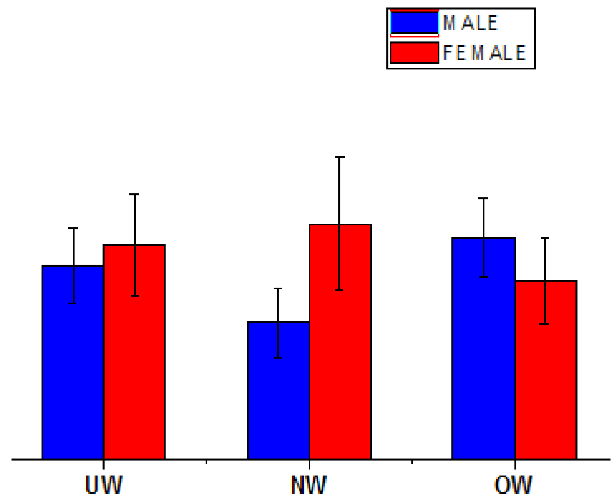
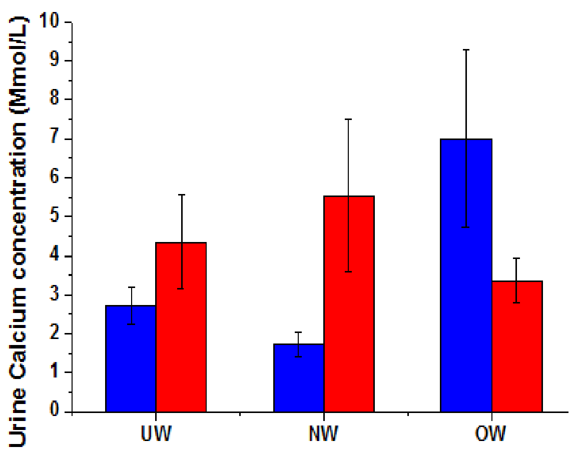


Diagram 3. BEFORE **Diagram 4. AFTER**

RAISED CHAMBER TEMPERATURE(RT= 37^{0}C, RH= 90%) RAISED CHAMBER TEMPERATURE (RT= 37^{0}C, RH= 90%)

FIG.II: SHOWING THE ***URINE CALCIUM CONCENTRATION*** IN INDIVIDUALS OF DIFFERENT BODY WEIGHT BEFORE AND AFTER INGESTING OF *COLA NITIDA* AT RAISED CHAMBER TEMPERATURE.



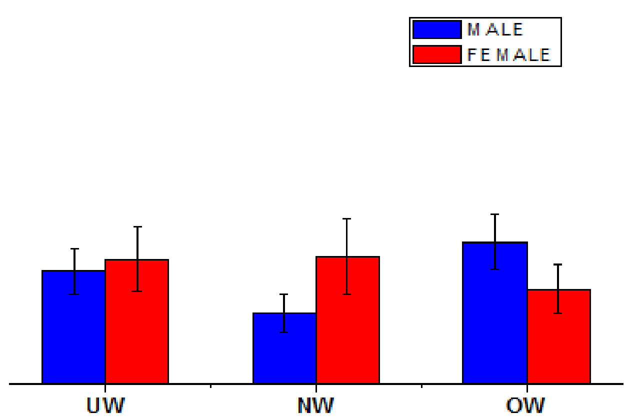
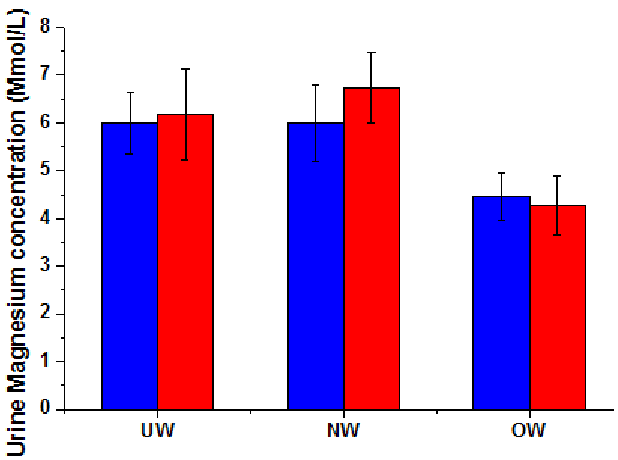


Diagram 5. BEFORE **Diagram 6. AFTER**

NORMAL CHAMBER TEMPERATURE WITH EXERCISE NORMAL CHAMBER TEMPERATURE WITH EXERCISE

(RT= 27⁰C, RH= 70%) **(RT= 27⁰C, RH= 70%)**

FIG.III: SHOWING THE ***URINE CALCIUM CONCENTRATION*** IN INDIVIDUALS OF DIFFERENT BODY WEIGHT BEFORE AND AFTER INGESTING OF *COLA NITIDA* AT NORMAL CHAMBER TEMPERATURE WITH EXERCISE.



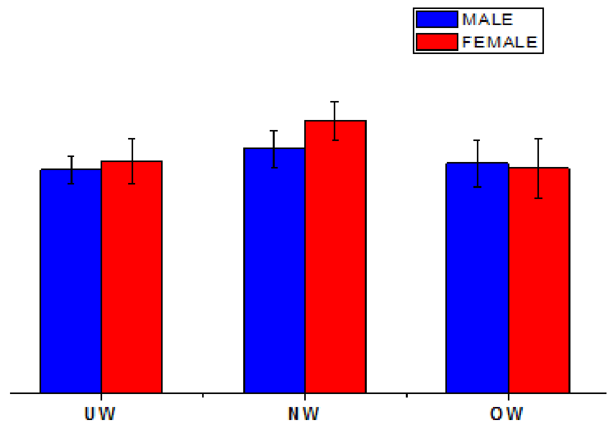
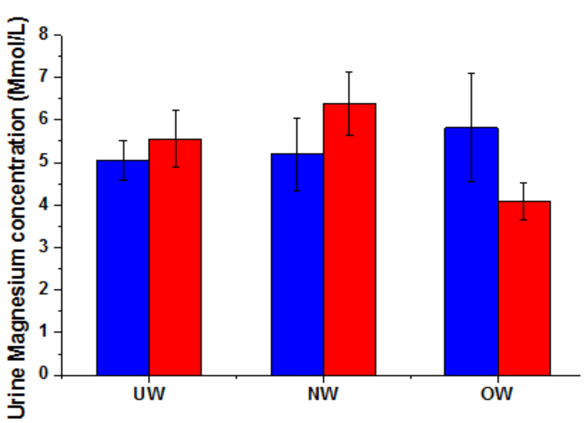


Diagram 7. BEFORE **Diagram 8. AFTER**

NORMAL CHAMBER TEMPERATURE(RT= 27⁰C, RH= 70%) NORMAL CHAMBER TEMPERATURE(RT= 27⁰C, RH= 70%)

FIG.IV: SHOWING THE ***URINE MAGNESIUM CONCENTRATION*** IN INDIVIDUALS OF DIFFERENT BODY WEIGHT BEFORE AND AFTER INGESTING OF *COLA NITIDA* AT NORMAL CHAMBER TEMPERATURE.



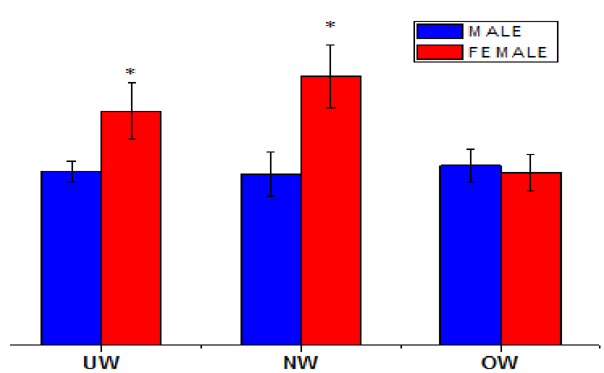


Diagram 9. BEFORE **Diagram 10. AFTER**

RAISED CHAMBER TEMPERATURE(RT= 37^{0}C, RH= 90%) RAISED CHAMBER TEMPERATURE (RT= 37^{0}C, RH= 90%)

FIG.V: SHOWING THE ***URINE MAGNESIUM CONCENTRATION*** IN INDIVIDUALS OF DIFFERENT BODY WEIGHT BEFORE AND AFTER INGESTING OF *COLA NITIDA* AT RAISED CHAMBER TEMPERATURE.

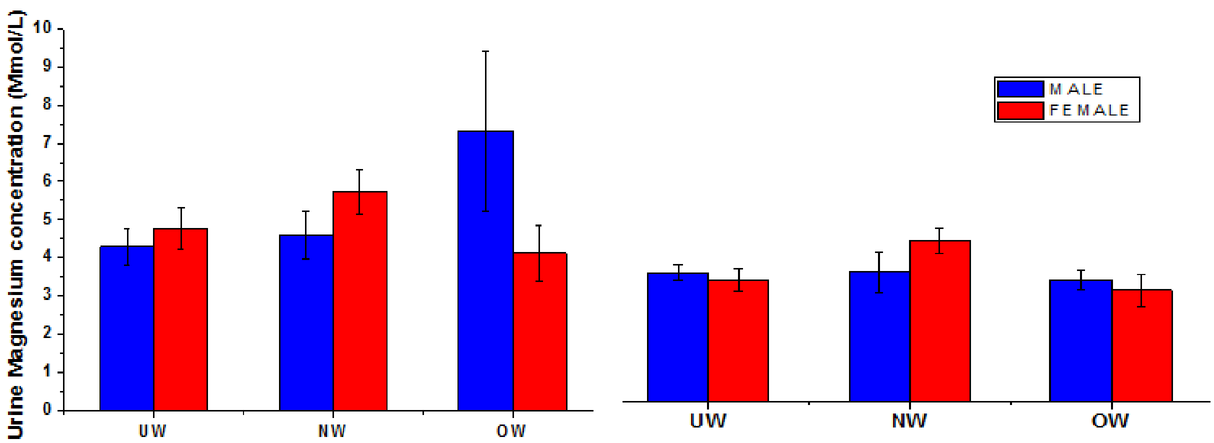


Diagram 11. BEFORE **Diagram 12. AFTER**

NORMAL CHAMBER TEMPERATURE WITH EXERCISE NORMAL CHAMBER TEMPERATURE WITH EXERCISE

(RT= 27^{0}C, RH= 70%) **(RT= 27^{0}C, RH= 70%)**

FIG.VI: SHOWING THE ***URINE MAGNESIUM CONCENTRATION*** IN INDIVIDUALS OF DIFFERENT BODY WEIGHT BEFORE AND AFTER INGESTING OF *COLA NITIDA* AT NORMAL CHAMBER TEMPERATURE WITH EXERCISE.

5. DISCUSSION

In respect to urine Ca ions concentration, no significant change was observed in a comparison between the males and females after the ingestion of *Cola nitida* under normal (Figure I), raised temperature (Figure II) and exercise (Figure III) experimental conditions.

This could be because of exercise-to-heat acclimatization which has been reported to conserve Ca^{2+} and Mg^{2+} (Troy *et al.*, 2008). The production of parathormone could have been stimulated which in turn would have led to the reabsorption of calcium in both the males and females. As regards urine Mg ions concentration, no significant change was observed in a comparison between the males and females after the ingestion of *Cola nitida* under normal (Figure IV) and exercise (Figure VI) experimental conditions. This could also be as a result of the explanations already highlighted above. However, there was a significant increase in Mg ions concentration in the female UW and NW subjects compared to the males after the consumption of *Cola nitida* under raised temperature condition (Figure V). It has been reported that the conservation of both Ca and Mg ions concentration are essential for exercise-to-heat acclimatization. That a significant increase was observed in the female UW and NW subjects Mg ions concentration could mean that they had some difficulty with acclimatization to heat exposure.

CONCLUSION

This study showed that ingestion of Cola nitida did not significantly alter urine calcium concentrations in either gender under normal, raised temperature, or exercise conditions. Similarly, no significant changes in magnesium concentrations were noted across normal and exercise conditions. However, a notable increase in magnesium levels was observed in underweight and normal weight females compared to males under elevated temperature conditions. This suggests potential gender-specific physiological responses to Cola nitida, particularly under heat stress.

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