BODY AND RECTAL TEMPERATURE CHANGES, RESPIRATORY AND HEART RATES OF NEW ZEALAND WHITE RABBITS ADMINISTERED *PANAX GINSENG* EXTRACTS

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ABSTRACT
High ambient temperature is one of the problems of the tropics, affecting temperatures, respiratory, and heart rates of livestock. This experiment lasted for 8 weeks and was carried out to explore the roles of Panax ginseng extracts PGEs on vital physiological parameters, which include body and rectal temperatures, respiratory and heart rates of New Zealand White (NZW) rabbits in their growing and adult phases. A total of 48 male and female (24 each) rabbits were used in a randomized complete block design (RCBD) of 3 treatments, replicated 4 times to contain 4 rabbits (2 males and 2 females) per replicate. The treatments were PGE0, PGE200 and PGE400, containing 0, 200, and 400 mg of PGEs, respectively. Body and rectal temperatures were measured using a digital clinical thermometer, while the respiratory and heart rates were measure with the aid of a stethoscope and a stopwatch. In the growing phase, respiratory rate only increased (P<0.05) in male growing rabbits on PGE400, while heart rate only increased (P<0.05) in male and female growing rabbits on PGE400. The adult phase recorded significant (P<0.05) reductions in body and rectal temperatures of female rabbits on PGE400, while respiratory and heart rates were significantly (P<0.05) higher in male rabbits on PGE400 only. The Results of this study indicates sex related effects on the roles of PGEs on body and rectal temperatures, respiratory and heart rates of male and female NZW rabbits.
Key words: Heart rate, Rabbits, Respiratory rate, sex effect, Temperature.

INTRODUCTION

The tropical environment is characterized by high temperature which negatively affects the body and rectal temperatures, respiratory and heart rates of livestock, thereby reducing efficiency of production (Popoola *et al*., 2014). Also the high cost of production, especially feed cost, which Results in high cost of the products often makes it difficult for low income earners to afford. High cost of feed materials and the untoward effects of synthetic materials like drugs and supplements used in livestock production have led to the search for alternative feed resources and natural materials, especially of plant origin, to perform the same roles in livestock production (Iwuji and Herbert, 2012). A lot of these natural materials of plant origin, of which one of them is Ginseng have been explored with different animal models (Kim *et al.,* 2005; Leung and Wong, 2013).

Ginseng is any one of the eleven species of slow-growing perennial plants with fleshy roots, belonging to the genus *Panax*, of the family *Araliaceae* (de Jong *et al.,* 2005). Ginseng contain a diverse group of steroidal saponins, labeled ginsenosides and other important chemical compounds (Ang-Lee *et al.,* 2001). Ginsenosides are thought to be adaptogenic (help the body adapt to stress) and are digested into pharmacologically active substances by intestinal microorganisms (Lee *et al.,* 2004). Various properties of *Panax ginseng* have been reported as follows; antioxidant properties, enhance immune function, synthesis of nitric oxide (Kim *et al.,* 2005); increases serum levels of luteinizing hormone (LH), follicle stimulating hormone (FSH), testosterone, spermatogenesis, and reduced prostate weight in rats (Leung and Wong, 2013; Oremosu *et al.,* 2013). Numerous other demonstrated properties of *Panax ginseng* include analgesic effects, anti-aging effects, anti-cancer effects, anti-inflammatory, antimicrobial, anti-platelet aggregation, lipid lowering effects, neurological effects, haematological effects, hepato-protective effects, and protein synthesis effects (Ahn *et al.,* 2006).

Over the years, animal model studies with ginseng have focused mainly on rats and mice which do not have the potential, like rabbits, to bridge the gap in animal protein supply of Nigerians. This study is therefore designed to explore the roles of *Panax ginseng* extracts on important vital physiological

parameters which include body and rectal temperatures, respiratory and heart rates of New Zealand White rabbits.

MATERIALS AND METHODS

This experiment lasted for 8 weeks and was carried out at the Rabbitry unit, Teaching and Research Farm, Federal University of Technology, Owerri, Imo State. Imo State is situated in Southeastern agro-ecological zone of Nigeria and lies between latitude 4°4' and 6°3' N, and longitude 6°15' and 8°15' E. Owerri is about 100 m above sea level with mean annual rainfall of 2500 mm, temperature range of 26.5 – 27.5 °C, and humidity range of 70 – 80 %. Dry season duration (months with less than 65 mm rainfall) is three months, which takes place during the months of December, January and February (Ogbuewu *et al.,* 2014).

The experimental material for this study was *Panax ginseng* extracts (PGEs). A commercially available capsulated pure *Panax ginseng* extracts (Mason natural® Korean Ginseng 518 mg) produced by MASON VITAMINS, INC. USA, was purchased from a reputable pharmacy. Each day, the contents of the *Panax ginseng* extracts capsule which weighed 500 mg without the capsule were dissolved in distilled water at the rate of 200 mg/ml and administered orally to the rabbits according to their treatment group. The preparation was as follows.

- 20 capsules or 10,000 mg of the *Panax ginseng* extracts (solute) were emptied into a graduated test tube.
- Distilled water (solvent) was then added and gradually stirred until all the solute were dissolved in the solvent and the volume of the solution made up to 50 mL.

Forty-eight New Zealand White (NZW) male and female (24 each) growing rabbits (average age of 2 months) were used for this study. The rabbits were purchased from a reputable farm in Umuahia, Abia State. On arrival, the rabbits were housed separately in four hutches of twelve cages each and allowed two weeks to acclimatize before administering the treatments. During the acclimatization period, the rabbits were injected with 0.1 mL vitoxy (an antibiotic) as a prophylactic measure.

The rabbits were then divided into three treatment groups, with sex (male and female) serving as the block. The treatments were orally given to the rabbits between the hours of 7am and 9am for 28 days, using a syringe. Diet of 17.33 % crude protein and 2627.58 metabolizable energy, and water were freely offered to the animals, while other standard management practices described by EL-Raffa (2004) and Mailafia *et al*. (2010) were carried out throughout the experiment.

The experiment was carried out in a Randomized Complete Block Design (RCBD) It was made up of three treatments; PGE_0, PGE_{200} and PGE_{400}, containing 0, 200, and 400 mg of *Panax ginseng* extracts (PGEs), respectively. Each treatment contained 16 rabbits with 4 replicates of 4 rabbits (2 males and 2 females) per replicate.

Data on body and rectal temperatures, respiratory and heart rates were collected in two phases: the growing phase and the adult phase. Temperatures (skin and rectal), respiratory and heart rates were measured in the morning (7.00 – 8.00 am) and in the afternoon (2.00 - 3.00 pm) twice a week throughout the experimental period, while record of daily ambient temperature and relative humidity was kept with the aid of a wet and dry bulb thermometer. Body/skin and rectal temperatures were measured by the use of a digital clinical thermometer. Respiratory and heart rates were measured using a stethoscope placed on the chest of the animal and counting the number of breaths and heartbeats, respectively; with minimum disturbance of the animal, and the readings taken per minute with a stopwatch.

Data collected were subjected to analysis of variance (ANOVA) according to Steel *et al*. (1997), using Statistical Package for Social Sciences (SPSS, version 25). Significantly ($P<0.05$) different means were separated using the least significant difference (LSD).

RESULTS AND DISCUSSION

The temperatures, respiratory and heart rates of the growing male and female rabbits are presented on Table 1. There were no significant ($P>0.05$) differences in the body and rectal temperatures of the growing rabbits. Respiratory rates were similar ($P>0.05$) among male rabbits on PGE_{200} (60.44 brpm), PGE_{400} (64.14 brpm) and female rabbits on PGE_{200} (60.30 brpm). Respiratory rates were also similar ($P>0.05$) among male rabbits on PGE_0 (58.02 brpm), female rabbits on PGE_0 (59.23 brpm) and PGE_{400} (59.43 brpm) which were similar ($P>0.05$) to respiratory rates of male rabbits on PGE_{200} and

female rabbits on PGE_{200}, but significantly ($P<0.05$) lower than respiratory rate of male rabbits on PGE_{400}. Heart rate of the male rabbits on PGE_{400} (160.31 bpm) and female rabbits on PGE_{400} (161.20 bpm) were similar ($P>0.05$), but significantly ($P<0.05$) higher than heart rates of male rabbits on PGE_0 (149.22 bpm), PGE_{200} (152.10 bpm), female rabbits on PGE_0 (152.49 bpm) and PGE_{200} (152.11 bpm). Heat stress is one of the problems facing rabbit production in the tropics (Popoola *et al*., 2014). However, there were no significant body and rectal temperature variations recorded among the growing male and female rabbits in this experimental. Considering the period of the experiment (rainy season), when temperatures are not high and recorded ambient temperatures which ranged 18 – 28 ^oC did not constitute heat stress for the rabbits and quite below the reported 32 ^oC and above (El-Raffa, 2004) for heat stress in rabbits. It therefore means that the animals did not have a temperature challenge during the course of the study. Furthermore, body and rectal temperatures of animals are largely affected by their environmental or extant ambient temperatures (EL-Raffa, 2004) and since the ambient temperature was not high enough to induce heat stress in the animals, their thermo-regulatory mechanism (homeostasis) will always keep their body and rectal temperatures within the comfort zone. Conversely, respiratory rate significantly increased in growing male rabbits receiving 400 mg of PGEs, but did not differ in the females; probably, at 400 mg administration of PGEs, the males may have needed more oxygen intake, following significant increase in metabolic rate to meet nutrient oxidation requirement. Heart rate significantly increased in both growing male and female rabbits at 400 mg of PGEs treatment. This could be attributed to increased metabolic activity, requiring more blood supply to the cells for more oxygen availability needed in nutrient oxidation (Zhang *et al*., 2001; Yang *et al*., 2003). It can then imply that sex is irrelevant in the heart rate response of growing rabbits to PGEs.

Table 1 Temperatures, respiratory and heart rates of growing rabbits administered *Panax ginseng* extracts

Parameters	Sex	PGE_0	PGE_{200}	PGE_{400}	SEM
Body temperature (^{o}C)	Male	39.28	39.32	39.10	0.19
	Female	39.30	39.36	39.24	
Rectal temperature (^{o}C)	Male	38.73	38.73	38.83	0.18
	Female	38.86	39.02	38.95	
Respiratory rate (brpm)	Male	58.02^b	60.44^{ab}	64.14^a	1.48
	Female	59.23^b	60.30^{ab}	59.43^b	
Heart rate (bpm)	Male	149.22^b	152.10^b	160.31^a	2.81
	Female	152.49^b	152.11^b	161.20^a	

^{ab}: Means within a row with different superscripts are significantly ($P<0.05$) different. PGE = *Panax ginseng* extract, SEM = standard error of means, brpm = breaths per minute, bpm = beats per minute.

Table 2 presents the body and rectal temperatures, respiratory and heart rates of adult rabbits administered *Panax ginseng* extracts (PGEs). Body and rectal temperatures of the male rabbits were similar ($P>0.05$) across the treatments, but the female rabbits on PGE_{400} recorded significantly ($P<0.05$) lower values than those on PGE_0 and PGE_{200} for body and rectal temperatures, respectively. On the other hand, respiratory and heart rates recorded significantly ($P<0.05$) higher values for male rabbits on PGE_{400} than for male on PGE_0 and PGE_{200}, and female rabbits on PGE_0, PGE_{200} and PGE_{400}, which were similar ($P>0.05$).

For the adult male rabbits, the absence of high ambient temperatures during the experiment, and the effect of PGEs may have contributed to the observed similar values obtained for body and rectal temperatures across the treatments, despite the increased respiratory and heart rate, indicative of increased metabolism (Zhang *et al*., 2001; Yang *et al*., 2003) at 400 mg administration of PGEs. The respiratory and heart rates of the experimental adult rabbit bucks were increased at the administration of 400 mg of PGEs to the animals. Since this situation leads to increased rate of oxygen supply to the alveoli (respiratory rate), and to maintain blood pressure in a probably increased blood vessel diameter, the heart rate needs to be increased. Increased blood vessels diameter and blood volume, leading to increased blood and oxygen flow for tissue respiration and synthesis, may have caused the significantly higher respiratory and heart rates recorded. Similar effect has also been reported in an experiment with shenfu injection (a traditional Chinese medicine having *ginseng* as a major

component) (Yang *et al*., 2003), where it was reported that shenfu among other effects in mice, increased the auricle micro-artery diameter, density of capillary and blood velocity in normal, epinephrine or endotoxin induced micro-circulation disturbance states.

In the female adult rabbits, the similar values recorded for respiratory and heart rates may be an indication that PGEs did not increase their metabolic rates. Therefore, the significant decrease in body and rectal temperatures of the adult female rabbits could be an expression of the effect of PGEs on thermo-regulatory mechanism of adult female rabbits.

Table 2 Temperatures, respiratory and heart rates of adult rabbits administered *Panax ginseng* extracts

Parameters	Sex	PGE_0	PGE_{200}	PGE_{400}	SEM
Body temperature (°C)	Male	39.99[a]	39.89[a]	39.96[a]	0.21
	Female	39.96[a]	39.82[a]	39.12[b]	
Rectal temperature (°C)	Male	39.63[a]	39.58[a]	39.57[a]	0.19
	Female	39.67[a]	39.51[a]	38.92[b]	
Respiratory rate (brpm)	Male	61.81[b]	63.02[b]	69.32[a]	1.97
	Female	58.22[b]	59.20[b]	60.12[b]	
Heart rate (bpm)	Male	131.50[b]	135.25[b]	146.85[a]	2.62
	Female	130.41[b]	132.55[b]	134.01[b]	

[ab]: Means within a row with different superscripts are significantly (P<0.05) different. PGE = *Panax ginseng* extract, SEM = standard error of means, brpm = breaths per minute; bpm = beats per minute.

CONCLUSION

Panax ginseng extracts (PGEs) increased metabolic rates in growing male and female, and adult New Zealand White (NZW) male rabbits, as evident by their increased respiratory and heart rates. There are indications of sex effects on body and rectal temperatures, and respiratory and heart rates at 400 mg administration in the adult rabbits. This study suggests potential benefits of PGEs in temperature, respiratory and heart rates regulations in NZW rabbits.

REFERENCES

Ahn, J. Y., Song, J. Y., Yun, Y. S., Jeong, G. and Choi, I. S. (2006). Protection of Staphylococcus aureus-infected septic mice by suppression of early acute inflammation and enhanced antimicrobial activity by ginsan. FEMS Immunology and Medical Microbiology. 46 (2): 187 - 197.

Ang-Lee, M. K., Moss, J., and Yuan, C. S. (2001). Herbal medicines and perioperative care. JAMA. 286 (2): 208 – 216.

Iwuji, T. C. and Udo, Herbert. (2012). Evaluation of the growth promoting effect of Garcinia kola seeds in growing rabbits. Journal of Global Biosciences, 1: 1 – 4.

Kim, S. H., Park, K. S., Chang, M. J. and Sung, J. H. (2005). Effects of Panax ginseng extract on exercise-induced oxidative stress. Journal of Sports Medicine and. Physical Fitness, 45 (2): 178 - 182.

Leung, K. W. and Wong, A. ST. (2013). Ginseng and male reproductive function. Spermatogenesis, 3 (3): e26391. https://www.ncbi.nlm.nih.gov/pubmed/24381805

Ogbuewu, I. P., Onyelekere, B. C., Etuk, I. F. and Ezeokeke, C. T. (2014). Physiological effect of egg laying on haematological and serum biochemical constituents of Japanese Quails (Coturnix coturnix Japonica). Nigerian Journaal of Animal Science, 16 (1): 85 – 93.

Oremosu, A. A., Arowosaye, V. O., Akang, E. N. and Bassey, R. B. (2013). Effects of Cissus populnea and Panax ginseng on flutamide-induced testicular defect in pre-pubertal male rats. British Journal of Medicine and Medical Research, 3 (1): 173 – 181.

Steel, R. G. D., Torrie, J. H., and Dickey, J. D. (1997). Principles and Procedures of statistics:A Biometrical Approach (3rd Ed.). McGraw Hill Book Co., New York, NY.

Zhang, Y. W., Dou, D. Q., Zhang, L., Chen, Y. J. and Yao, X. S. (2001). Effects of ginsenosides from Panax ginseng on cell-to-cell communication function mediated by gap junctions. Planta Medica, 67 (5): 417 - 422.

El-Raffa, A. M. (2004). Rabbit production in hot climates. Proceedings of 8th World Rabbit Congress. September 7 – 10. Pueblo, Mexico.

Lee, B. H., Jeong, S. M., Lee, J. H., Kim, D. H., Kim, J. H., Kim, J. I., Shin, H. C., Lee, S. M., and Nah, S. Y. (2004). Differential effect of ginsenoside metabolites on the 5-HT3A receptor-mediated ion current in Xenopus oocytes. Molecles and Cells, 17 (1): 51 - 56.

Mailafia, S., Onakpa, M. M. and Owoleke, O. E. (2010). Problems and prospects of rabbit production in Nigeria – A review. Bayero Journal of Pure and Applied Science, 3 (2): 20 – 25.

Popoola, M. A., Oseni, S. O. and Ajayi, B. A. (2014). Evaluation of heat tolerance of heterogenous rabbit population raised in Southwestern Nigeria. Global Journal of Animal Scientific Research, 2 (3): 205 – 209.

Yang, F., Zheng, Y., Li, D. and Deng, W. (2003). Effect of shenfu injection on microcirculation. Journal of Biomedical Engineering, 20 (1): 91 - 94, 100.