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EFFECT OF DIETARY *CALOPOGONIUM MUCUNOIDES* AND ORANGE-FLESHED SWEET POTATO VINE ON RABBIT REPRODUCTIVE PERFORMANCE, HAEMATOLOGY, AND ANTIOXIDANT PROFILE

Article Info

Keywords: Rabbit bucks; *Calopogonium mucunoides*; orange-fleshed sweet potato vine (OFSP); Semen quality; Oxidative stress; Humid tropical environment

Abstract

The study examined the effect of *Calopogonium mucunoides* and orange-fleshed sweet potato vine on the physiology, reproduction, and antioxidants of male rabbits. The experimental study utilized a completely randomized design with four treatment diets – control, *Calopogonium mucunoides* (CM), orange-fleshed sweet potato vines (PV), and PVCM. Data collection involved measurements of growth, libido, sperm characteristics, haematology, antioxidant enzymes, and hormones during experimental periods. Data obtained from the experiment was statistically analyzed using factorial analysis of variance (ANOVA) by using General Linear Model (GLM), with means being separated using Duncan Multiple Range Test, using the $p < 0.05$ criterion. Results showed that the effects were complex and dynamic, where PV and PVCM improved libido, semen volume, and sperm motility and minimized abnormal sperms. Despite all these, antioxidant enzymes like GPX showed reduction with time, and there were elevated levels of cortisol alongside lowered testosterone hormone. This meant that oxidative and physiological stress were also felt even though there was a nutritional gain. The haematological parameters showed signs of adaptations, which is indicative of improved immune response of the body physiology to blood components. In conclusion, the study revealed that the experimental diets possessed some promising effects in improving reproductive traits as well as certain physiological responses, it was not completely positive in nature, as long-term intake seemed to cause minor metabolic and endocrine disturbances. It therefore recommends that the future diets should take into account other antioxidants in addition to including optimal amounts of the same along with stress handling measures for the environment.

1. Introduction

The search for sustainable rabbit production systems in the tropics has seen an increasing interest in non-conventional feed sources and their physiological impact. Indeed, rabbits, especially bucks, have shown to be quite sensitive to environmental factors and nutritional inputs, with direct physiological impacts on reproductive function, haematology, and oxidative status. For savannah climates which are humid, temperature and moisture changes create a problem for metabolic processes that affect libido, fertility, and hormonal system performance (Ajao & Ola, 2021; Okukpe et al., 2026). It is against this background that nutritional intervention emerges not just as additional input but also as one of the critical factors influencing physiological resilience. The plant-based feeds, such as *Calopogonium mucunoides* and orange-fleshed sweet potato (OFSP) vines, contain important bioactive elements, vitamins, and antioxidants, that might be useful in improving the reproductive and health status. Several studies have shown that plant-based feeds enhance the efficiency of sperm quality, haematology, and antioxidant systems in bucks (Ajuogu et al., 2018; Ajao & Ola, 2022; Babaniyi, 2023; Ajao et al., 2025). However, it appears that very little is known about the physiological effects that occur when these two feeds are taken concurrently by bucks.

However, rabbits raised in Nigeria and agro-ecosystems characterized by such humid, temperature and moisture changes continue suffering from low reproduction performance, poor semen quality, and physiological disorders resulting from inadequate nutrition and oxidative stress. Traditional sources of rabbit feed have become too costly and even lacking in nutritive values. There is, therefore, an urgent need for more affordable and effective sources of feeds to be explored. Although studies have been done regarding the individual influence of the use of OFSP vine or other plant supplements, limited research is available on the integration of *Calopogonium mucunoides* with OFSP vine to improve reproductive, hematological, and antioxidative status of rabbits. Oxidative stress, which has been found to adversely affect sperm cell vitality and physiology, is seldom considered comprehensively in studies about the efficacy of feeding rabbits (Ajao et al., 2022; Liang et al., 2022).

When it comes to production, finding sources of feeds that can help improve reproduction performance may be very important for improving the success of rearing rabbits. Both OFSP vine and *Calopogonium mucunoides* are leguminous forages, where the latter contains high protein content and the former helps provide vitamins, including beta-carotene that has been associated with antioxidant benefits. Using both of them simultaneously may allow creating some synergy effect for preventing oxidative stress as well as enhancing reproduction performance. There is some evidence indicating the positive role of both feeds in relation to growth and physiological parameters (Ajao et al., 2022; Babaniyi, 2023; Ajao et al., 2025), but much less information is available in other contexts. Against this backdrop, the main aim of the current study is to conduct an assessment of the effect of incorporating *C. mucunoides* and OFSP vine in the diet of rabbits on their reproductive efficiency, haematological parameters, and antioxidant status.

From a scientific perspective, this study is relevant because of its contribution to existing literature on functional feeds and nutraceuticals in livestock production. It makes connections between several fields from nutrition to reproduction and oxidative physiology as well provides information that might prove useful for feed development and management. In addition, the focus on oxidative balance along with conventional measures of animal performance reflects new trends in the field, where emphasis is placed on animal health as the key prerequisite to productivity.

2.0 Materials and Methods

2.1 Study and Ethics

The experiment was conducted in accordance with ethical approval from the Ethical Review Committee, UERC/ASN/2024/2715, of the University of Ilorin, Ilorin, Nigeria. This study was carried out for eight weeks on rabbits farm located at Ganmo, Kwara State, Ifelodun Local Government Area, on latitude 8.41900N and longitude 4.60360E.

Clinical trial number: not applicable.

2.2 Experimental design

A total of twenty-four adult rabbits bucks (with body weights averaging 1.25 kg) aged between 6 and 8 months were used in this experiment. They were individually kept in wooden cages measuring 35 cm x 42 cm x 54 cm, and which had wire-mesh floors and corrugated iron roofs. Four diets were prepared. These were made up of the concentrate feeds, which were whole, in equal amounts of 150 g per animal, together with four forage treatments that comprised of the control diet (with only concentrate feeds) and the following forages: *Calopogonium mucunoides* (CM), orange-fleshed sweet potato vines (PV), and combination of *Calopogonium mucunoides* (CM), and orange-fleshed sweet potato vines (PV) (PVCM). In preparing the latter diet, 10 kg each of the CM and PV forages were thoroughly mixed. The twenty-four animals used were randomly divided among the four diets, depending on their body weights, into six in each group. These animals were fed feed and water *ad libitum* for the entire duration of the experiment. Also, twenty kilograms of concentrates were supplied to each group.

2.3 Evaluation of weight and Libido

The body weight of the rabbits was measured weekly using a digital weighing balance. To assess libido, a teaser doe was introduced to three bucks within each experimental treatment group for a period of 3 minutes. The time taken by each buck to initiate the first mount on the doe was recorded as the reaction time, which served as an indicator of libido. This procedure was conducted at weekly intervals throughout the duration of the study.

2.4 Collection of Semen and Analysis

Semen samples were collected on weekly basis for eight weeks using a modified artificial vagina that was kept at 45 °C. Three bucks per treatment were used during the semen collection process, which was carried out in conjunction with teaser does following the method proposed by Ajao and Ola (2022). The sampling was done within the period of 08:00 am and 10:00 am. While obtaining semen, as the buck mounted and attempted to thrust on the teaser does before intromission, the artificial vagina was carefully fitted from behind to stimulate ejaculation. The collected semen was analyzed right away as per the IRRG (2005) criteria. The volume of semen collected was determined using the calibration of the collection tube. Motility evaluation was done using a drop of semen without dilution and placed on a warmed glass slide of 37°C and viewed under a light microscope at a magnification of ×400. Viability test of sperm was done through eosin–nigrosin staining. Semen sample was taken, mixed with eosin-nigrosin dye, smeared on a glass slide and viewed under a microscope (x400 magnification). Living sperm showed no stain, whereas nonviable sperm-stained pink in color. Morphological analysis of the semen was done by preparing a smear of the eosin–nigrosin-stained semen on a glass slide covered with a coverslip inclined at 45°. This smear was air dried at room temperature for 10-15 minutes, after which it was examined under a microscope at x1000 magnification for identification of morphological defects. The concentration of sperm cells was measured by improved Neubauer hemocytometer. Ten microliters of semen sample was diluted at 1:100 in normal saline solution. Two drops of formalin solution were added to preserve and fix the sperm cells. The prepared suspension was introduced to the counting chamber, and the sperm cell count was done subsequently. The total number of sperm counted was referred to as N. sperm count (SC) and sperm concentration (SCN) was obtained by the following equation:

$$SC = N \times 10000 \times \text{dilution factor/ml of semen}$$

(where: SC = total number of counted sperm cells)

2.5 Determination of Haematology, Hormone and Enzymes

2 mL of blood sample was collected from the ear veins of the bucks during week one (beginning of the experiment) and at week eight (end of the experiment). Blood samples to be used for hematological analyses were collected in test tubes containing EDTA and analyzed based on the procedures described by Ewuola et al. (2012) and Jain (1986). In addition, some blood samples were taken in plain test tubes for the purpose of serum extraction and the determination of hormone and antioxidant levels. Peripheral levels of testosterone, cortisol, as well as catalase, superoxide dismutase, and glutathione peroxidase enzymes levels were measured based on the methods specified by Jimoh (2019) and Ewuola et al. (2012).

2.6 Statistical Analysis

The data collected from the experiment were analyzed by factorial analysis of variance (ANOVA) using General Linear Model (GLM) for completely randomized designs (CRD). The means of the treatments were compared and separated using Duncan's Multiple Range Test with significance determined and concluded at the level of $p < 0.05$. The statistical analyses of the data were done using the IBM Statistical Package for the Social Sciences (SPSS), version 21.0. The experimental model described below was used to analyze the animal's response in the experiment:

$$Y_{ijklm} = \mu + A_i + B_j + C_k + B_n C_{jk} + E_{ijkl}$$

Y_{ijklm} = response variables; μ = population mean; A_i = effect of formulated concentrate; B_j = effect of orange - fleshed sweet potato vine (PV); C_k = effect of *C. mucunoides* (CM); $B_n C_{jk}$ = combined effect of PV and CM; E_{ijkl} = residual error

3.0 Results

Weekly Body Weight and Libido of Experimental Rabbit Bucks

Body weight had a relatively stable and increasing trend throughout the weeks, indicating that sufficient support for weight maintenance and slow growth was provided, and that this was consistent with observations of Ajao et al. (2022) and Okukpe et al., (2026) that proper nutrition maintains physiological stability in rabbits. On the other hand, libido (LIBD) had significant variations, peaking sharply in week 2 and week 4 before declining, indicating that libido can be highly influenced by temporary physiological or environmental factors and not weight alone (Ajao & Ola, 2021). This decrease in libido during the latter part of the experiment might suggest an increasing level of oxidative or thermal stress, both of which have been found to negatively affect reproductive behavior and hormonal homeostasis in bucks (Liang et al., 2022). Overall, this poor correlation between weight and libido supports the hypothesis that male reproduction behavior depends more on physiological factors than growth, similar to previous studies on the relationship between nutritional components and semen quality/sex-drive (Ajao & Ola, 2022).

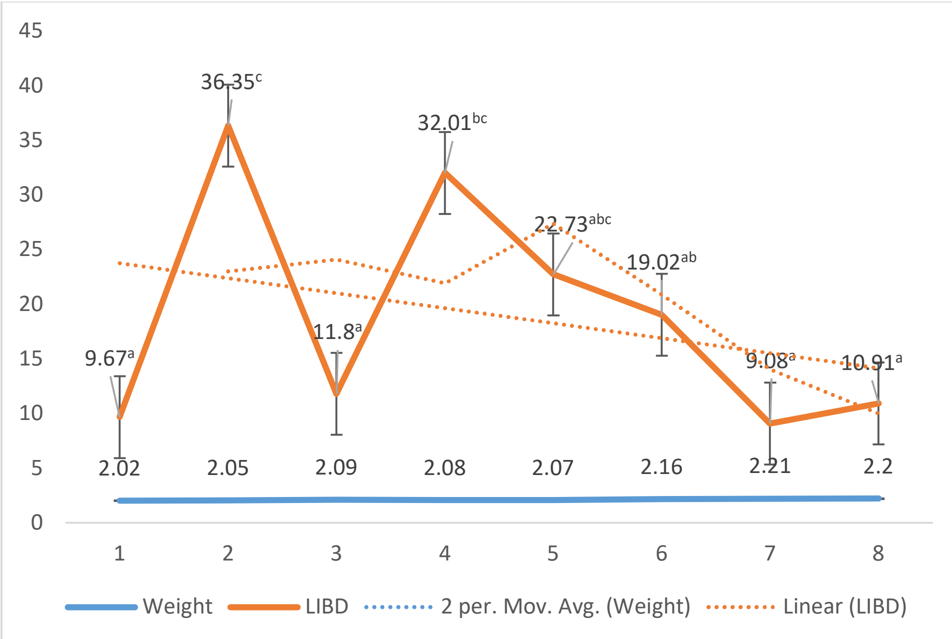

Figure 1: Weekly Body Weight and Libido of Experimental Rabbit Bucks

Figure 1 shown that there was a relatively steady body weight, with an upward trend throughout the weeks, indicating that sufficient nourishment and support were provided for maintaining and gradually growing body weight, which correlates with the fact that balanced nutrition promotes physiological stability in rabbits (Ajao et al., 2022). In contrast, the libido exhibited clear variations, having two peaks, which occurred at week 2 and week 4, with a subsequent fall, which could mean that the sexual drive can be highly affected by some factors other than body weight because the sexual drive is sensitive to changing conditions (Ajao & Ola, 2021). It might suggest that there was increasing oxidative or thermogenic stress during the study, both of which negatively impact reproductive behavior in males (Liang et al., 2022). Also, poor correlation between weight and libido indicates that reproduction is mainly influenced by physiological conditions and the presence of antioxidants in the body, confirming claims that semen quality and libido depend more on diet than on weight change (Ajao & Ola, 2022).

Table 1: Dietary Influence of *Calopogonium mucunoides* and OFSP Vine on Weight and Libido of Rabbit Bucks

Week	Weight	LIBD
C	2.18[b]	13.48[a]
CM	1.96[a]	17.45[a]
PV	2.17[b]	15.02[a]
PVCM	2.14[b]	29.83[b]
p-value	0.02	0.02
SEM±	0.04	3.32
Grand Mean	2.11±0.02	18.95±1.66

SME = standard error mean; LIBD = Libido; C = Control; CM = Calopogonium Mucunoides; PV = Orange-fleshed potato vine

The Table 1 revealed that CM significantly lowered the body weight compared to control and other treated groups (p<0.05), implying either restrictions in utilization of nutrients or anti-nutritive effects that could lower growth rate, similar to the growth rate variability in response to forage-based supplementation as reported by Olaleru (2021) and Ajao et al. (2022). On the other hand, the PVCM mixture had a high libido score, meaning the combination enhanced the expression of reproductive traits, which is similar to the report of El-Desoky et al. (2017), and Ajao and Ola (2022), showing that dietary supplements can enhance reproductive behavior and semen quality through modulation of endocrine and antioxidant systems (Ajao & Ola, 2022; El-Desoky et al., 2017). In general, the statistical significance of results (p=0.02) implies that the diets had distinct impacts on the measured growth and reproductive characteristics. This is because the physiological balance between the growth and reproduction in rabbits is usually linked to their oxidative and nutritional state (Liang et al., 2022; Okukpe et al., 2026)

Table 2: Seminal Characteristics of the experimental Rabbit Bucks

Week	SV	pH	PGM	MOT	TMC	SC	ABN
1	0.76^{abc}	7.58	69.50^{c}	0.72^{b}	93.16^{a}	166.67^{a}	9.58^{a}
2	0.75^{abc}	7.83	67.92^{bc}	0.78^{ab}	117.53^{a}	187.42^{a}	15.16^{ab}
3	0.68^{ab}	7.83	51.67^{a}	0.60^{a}	230.93^{ab}	390.67^{b}	9.50^{a}
4	0.63^{a}	7.75	61.67^{bc}	0.73^{b}	121.93^{a}	299.25^{ab}	22.13^{bc}
5	0.65^{ab}	8.00	70.50^{c}	0.84^{c}	200.42^{ab}	416.58^{b}	22.29^{bc}
6	1.03^{cd}	7.83	59.17^{ab}	0.71^{b}	418.72^{c}	593.75^{c}	17.13^{b}
7	0.94^{bcd}	7.75	65.42^{bc}	0.75^{b}	82.24^{a}	124.08^{a}	27.29^{c}
8	1.08^{d}	7.42	61.25^{bc}	0.70^{b}	299.94^{bc}	388.33^{b}	72.71^{d}
p-value	0.02	0.06	0.02	0.02	0.02	0.02	0.02
SEM±	0.10	0.13	3.07	0.03	53.91	60.55	2.43

SME = standard error mean; SV = Seminal volume; PGM = Progressive motility; TMC = Total motility count; SC = Sperm concentration; ABN = Abnormal Sperm Cells

Table 2 shown that seminal volume (SV) showed a statistically significant trends towards higher levels in later weeks with the highest level at week 8 (p<0.05). This implies that the accessory glands were functioning more efficiently and producing more semen, respectively, as observed by IRRG (2005), Ajao and Ola (2021), and Ajao et al. (2025) in rabbits. Likewise, there were considerable variations in PGM, MOT, TMC, and SC values (p<0.05) as high values were noted in weeks 5 and 6 indicating increased spermatogenesis and viability of spermatozoa. This is similar to the report of El-Desoky et al. (2017), and Ajao and Ola (2022) which revealed that the impact of nutrition and environment on semen quality may be modulated by oxidative stress defense system and hormonal action. Semen pH was rather steady (p>0.05), although small deviations in pH levels observed indicate the maintenance of an optimal pH environment for sperm survival, in line with the report of Jain (1986), reporting the stability of rabbit semen pH to short-term physiological variations. The rapid increase in ABN, especially by week 8, is indicative of emerging reproductive stress or potential oxidative damage, thus illustrating a possible trade-off between the quantity of produced spermatozoa and their viability due to the influence of long-term physiological or environmental stressors (Jimoh, 2019; Liang et al., 2022).

Table 3: Seminal Characteristics of the Experimental Rabbit Bucks fed *Calopogonium mucunoides* and OFSP Vine

Week	SV	pH	PGM	MOT	TMC	SC	ABN

C	0.63^{a}	7.58^{a}	55.79^{a}	0.66^{a}	157.53^{a}	361.42	26.83^{b}
CM	0.68^{a}	7.63^{a}	64.67^{b}	0.72^{b}	142.71^{a}	289.13	25.71^{b}
PV	1.06^{b}	7.88^{b}	68.13^{b}	0.77^{b}	286.54^{ab}	339.88	19.63^{a}
PVCM	0.90^{b}	7.92^{b}	64.96^{b}	0.75^{b}	195.45^{b}	292.96	25.73^{b}
p-value	0.02	0.01	0.02	0.02	0.04	0.56	0.02
SEM±	0.07	0.09	2.17	0.02	38.12	42.81	1.72
Grand Mean	0.82±0.03	7.75±0.04	63.39±1.09	0.73±0.01	195.61±19.06	320.84±21.41	24.47±0.86

SME = standard error mean; SV = Seminal volume; PGM = Progressive motility; TMC = Total motility count; SC = Sperm concentration; ABN = Abnormal sperm cells; C = Control; CM = Calopogonium Mucunoides; PV = Orange-fleshed potato vine

Table 3 further revealed that SV and semen pH levels were significantly increased among the groups fed with PV and PVCM ($p<0.05$), indicating better performance of the accessory glands, as well as better semen quality. The trends are consistent with the findings of IRRG (2005) and Ajao and Ola (2022) that plant-based dietary supplementations increase fluid dynamics in rabbits. PGM and MOT were both significantly elevated in the experimental diet groups compared to controls ($p<0.05$), suggesting a significant role played by both *Calopogonium mucunoides* and orange-fleshed sweet potatoes' vines to boost sperm motility, most likely due to their ability to protect cells from oxidative stress as described by El-Desoky et al. (2017) and Liang et al. (2022). Highest Total Motile Count (TMC) was observed in the groups fed PV and PVCM, but statistically not significant ($P<0.05$), showing improved sperm production efficacy and motility, whereas the Sperm Concentration (SC) was similar among all treatments ($P>0.05$), implying that the nutritional diet impacted sperm quality rather than quantity, similar to what has been established by Ajuogu et al. (2018) for rabbit reproductive physiology. It is also important to state that the lowest number of abnormal sperm cells (ABN) was detected in the PV treatment group ($P<0.05$), showing its superiority in preserving the structure of sperm cells, attributed to its potent antioxidative content.

Table 4: Haematological Characteristics of the Experimental Rabbit Bucks fed *Calopogonium mucunoides* and OFSP Vine

Parameters	Period	Ctrl	CM	PV	PVCM	p-Value	SEM±	Grand Mean
WBC	Initial	7.23	7.43	9.60	8.97	0.66	6.27	8.53±1.81
	End	3.00	4.10	30.27	5.27			
RBC	Initial	5.20^{B}	5.64^{B}	5.13^{B}	5.53^{B}	0.01	0.43	4.81±0.13
	End	3.97^{A}	4.27^{A}	3.70^{A}	4.43^{A}			
HGB	Initial	9.00^{aB}	8.90^{abB}	8.60^{abB}	9.13^{bB}	0.02	0.80	8.05±0.23
	End	5.03^{aA}	6.13^{abA}	7.70^{abA}	8.90^{bA}			
HCT	Initial	39.50^{aB}	40.40^{bB}	39.07^{aB}	41.20^{aB}	0.00	2.35	29.68±0.68
	End	17.40^{aA}	29.30^{bA}	23.00^{aA}	26.67^{aA}			
MCV	Initial	76.07^{B}	71.80^{B}	76.30^{B}	74.63^{B}	0.00	3.43	66.43±0.99
	End	60.10^{A}	60.07^{A}	62.13^{A}	59.97^{A}			
MCH	Initial	17.33^{bA}	15.87^{aA}	16.80^{bA}	16.53^{bA}	0.00	0.55	18.40±0.16
	End	18.12^{bB}	14.24^{aB}	20.80^{bB}	20.03^{bB}			
MCHC	Initial	22.80^{A}	22.07^{A}	21.97^{A}	22.17^{A}	0.00	1.35	28.28±0.39
	End	28.97^{B}	21.05^{B}	33.48^{B}	33.38^{B}			
	Initial	59.83^{aA}	52.00^{bA}	43.20^{aA}	48.27^{cA}	0.00	7.26	76.08±2.10
LYM	End	51.00^{aB}	101.00^{bB}	55.00^{aB}	69.00^{cB}			

abAB Means with different superscript within the columns and across the rows are significantly different (P < 0.05), SEM = Standard error mea; WBC = White Blood Cell, RBC = Red Blood Cell, HCT = Haematocrit (PCV = Packed Cell Volume), HGB = Haemoglobin, MCV = Mean Corpuscular Volume; MCH = Corpuscular Haemoglobin; MCHC = Corpuscular Haemoglobin Concentration; C = Control; CM = Calopogonium Mucunoides; PV = Orange-fleshed potato vine

The Table 4 revealed non-significant differences in WBC (p>0.05) among treatment groups despite the obvious increase in PV at the end of the experiment, imply an enhancing but inconsistent immune reaction, suggesting that orange-fleshed sweet potato vine might promote leukocyte proliferation under specific physiological conditions, similar to immune regulation due to nutrition in rabbits (Ewuola et al., 2012; Liang et al., 2022). There was a significant decrease in RBC, HGB, and HCT levels between initial and end (p<0.05), but the higher level of HGB in PVCM at the end indicates enhanced oxygen transport capabilities under dietary treatment conditions, consistent with findings of Ajao and Ola (2021) and Okukpe et al. (2026) that phytogenic feed diets help mitigate stress-related haematological suppression. The significant decline in MCV accompanied by rises in MCH and MCHC towards the end (p<0.05) is indicative of a trend toward higher hemoglobin concentration within erythrocytes, implying erythropoietic adaptations likely prompted by diet-induced nutrient quality and antioxidant effects in the blood, consistent with the documented responses to the consumption of plant-based dietary supplements in rabbits as established by Jain (1986) and El-Desoky et al. (2017). The lymphocyte (LYM) level showed a significant increase especially among the CM group at the end stage (p<0.05), suggesting an increased immune response, probably owing to disease resistance and immuno-competency due to the use of leguminous forage in addition, consistent with the studies of Ewuola et al. (2012) and Ajuogu et al. (2018) that found plants as sources of feed ingredients capable of stimulating rabbit immunity.

Table 5: Oxidative Stress and Hormonal Responses of Rabbit Bucks Fed *Calopogonium mucunoides* and Orange-Fleshed Sweet Potato Vine

Parameters	Period	Ctrl	CM	PV	PVCM	p-Value	SEM±	Grand Mean
GPX	Initial	263.70^{B}	173.68^{B}	256.95^{B}	227.69^{B}	0.00	40.47	146.68±11.68
	End	170.91^{A}	156.49^{A}	173.56^{A}	169.47^{A}			
Catalase	Initial	10.10	8.53	16.55	4.97	0.92	3.90	10.36±1.13
	End	16.22	8.60	8.35	10.83			
SOD	Initial	0.87	0.21	0.84	1.16	0.28	0.26	0.66±0.07
	End	0.84	1.16	0.30	0.61			
Testosterone	Initial	7.07^{B}	8.95^{B}	7.51^{B}	1.53^{B}	0.01	1.65	3.98±0.48
	End	1.00^{A}	1.45^{A}	1.47^{A}	0.65^{A}			
Cortisol	Initial	4.95^{abA}	5.69^{aA}	5.66^{bA}	5.70^{abA}	0.00	2.05	23.03±0.59
	End	14.15^{abB}	11.70^{aB}	15.51^{bB}	11.71^{abB}			

abAB Means with different superscript within the columns and across the rows are significantly different (P < 0.05), SEM = Standard error mean; C = Control; CM = *Calopogonium Mucunoides*; PV = Orange-fleshed potato vine

Table 5 revealed that the decrease in the level of glutathione peroxidase (GPX) from initial to end (p<0.05) might be attributed to antioxidant capability exhaustion due to the constant presence of physiological and/or environmental stressors, which could imply that the antioxidant systems were increasingly being exhausted despite dietary treatment, a trend that was common among rabbits exposed to the tropics (Jimoh, 2019; Liang et al., 2022). The levels of Catalase and superoxide dismutase (SOD) did not exhibit any remarkable difference (p>0.05). However, the numerical variation in their levels reveals some alterations in their enzymes' activities. Thus, it can be concluded that Catalase and SOD enzymes are quite stable and require prolonged exposure or dietary intake to elicit a response. A significant decrease in testosterone was observed for all treatments at the end of the experiment ($p<0.05$), an indication of low reproductive hormonal activity, possibly due to stress and/or metabolic stressors, which corroborates the claim of Ajao and Ola (2021), and Liang et al. (2022) that stress and oxidation reduce endocrine activity and sex drive in rabbit bucks. Also, cortisol levels showed a significant increase in all treatments ($p<0.05$), especially in the group fed PV treatment, an indication of increased stress and stimulation of the hypothalamus-pituitary-adrenal (HPA) axis, hence proving the inverse relationship between stress hormone levels and reproductive efficacy during stress conditions (Ajao & Ola, 2021; Jimoh, 2019).

4.0 Conclusion and Recommendation

4.1 Conclusion The results obtained, it is evident that there was a mixed effect of nutrition, physiology, and environment on male rabbits' performance. It is clear that the inclusion of *Calopogonium mucunoides* and orange-fleshed sweet potato vine in the diet brought about positive changes in libido, semen characteristics, and some hematological parameters. On the other hand, the reduction in the activity of antioxidant enzymes and testosterone hormone levels pointed to hidden physiological problems brought about by the inclusion of the plants in the rabbit's diet. Although, there are potential benefits associated with incorporating the experimental diets in a rabbit's diet, these benefits are not straightforward and are influenced by metabolic challenges. The increase in cortisol hormone, sperm abnormalities, and erythrocyte levels indicates that the rabbit bucks are trying to adapt to the changes occurring in their body. However, the process requires energy, and as such, the organisms will have to adapt to the tropics' challenging conditions.

4.2 Recommendation

Future diets for rabbits should include not only the tested diets but also better sources of antioxidants in order to minimize oxidative stress and stabilize hormones. The quantities needs to be regulated since too much can make the advantages turn disadvantages in terms of inducing physiological stress. Moreover, providing proper temperature regulation and performing extended studies in order to examine molecular mechanisms and hormonal processes will ensure the formulation of better diets for rabbits.