IOSR Journal of Biotechnology and Biochemistry (IOSR-JBB)
ISSN: 2455-264X, Volume 1, Issue 5 (Jul. – Aug. 2015), PP 15-21
www.iosrjournals.org

Effects of Oral Administration of Selected Food Seasonings Consumed in Nigeria on Some Sex Hormones of Wistar Albino Rats

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Abstract:
Background: *The objective of this study was to evaluate the effect of 4 selected food seasonings (labeled IS, KC, SMC and BS) commonly consumed in Nigeria on some sex hormones- Testosterone, Estrogen and Progesterone of wistar albino rats.*
Method: *A total of 117 male and female rats with average weight of 120g were used. Animals were grouped into 5 groups, with 9 rats in each group. Group 1 represents the control, while group 2-5 represents the treatment group. Oral administration of 1mg/g, 2mg/g and 4mg/g body weight of each seasoning were administered to rats in the treatment group. Those in the control group received growers mash and water. From each group, 3 rats were sacrificed weekly for 3 weeks to determine the serum concentrations of these sex hormones.*
Result: *This showed a dose dependent increase in the weight of rats. There was a significant ($P<0.05$) decrease in the concentration of the male sex hormone- testosterone in treated rats. Also, a significant ($P<0.05$) increase in the concentration of the female reproductive hormones-estrogen and progesterone was observed in treated rats when compared with the control.*
Conclusion: *These observations, suggests that components of these seasonings may have the ability of altering the normal concentrations of these sex hormones.*
Keywords: *Seasonings, Testosterone, Estrogen, Progesterone, weight.*

I. Introduction

Food additives are substances not commonly regarded or used as food, but are added to food at any stage to affect its keeping quality, texture, consistency, taste, colour, alkalinity or acidity. They also serve any other technological function in relation to food which includes processing aids (21). Food additives become part of a food in the process of processing, packaging and storage. Some examples of food additives include: Preservatives, colour enhancers, sweetners, emulsifiers, humectants , flavour enhancers/seasoners e.t.c .

Food seasonings are ingredients that are added to foods to enhance their flavour and taste (14). Enhancing the natural flavour and taste of food is part of the art of cooking. Everyone expects delicious and flavourful dishes either when they cook it themselves or visits a food vendor. A wide variety of ingredients can be used to flavour and season food. Salt and pepper are two of the most common seasonings that are used. In Nigeria, food condiments and seasoning are in high demand and it is the key to cooking among many Nigerians.

A wide variety of seasoning brands are used in Nigeria to flavour and season food. The raw materials research and development council of Nigeria, has indicated that the bouillon and seasoning/culinary sub-sector of the food, beverages and tobacco sector in Nigeria had a favourable growth over the period in the year 2000-2003, with production output increasing by 50-100% and an approximate average current capacity utilization of 87% (19) . Bouillon cubes are taste enhancers. When added to foods they augment the taste properties of such foods (1). There are several brands of food seasonings readily available in the open markets, in-street shops and supermarkets. These include: Star maggi, knorr, royco, doyin, jumbo (cubes), Onga, Mixpy, Benny, Aluba shrimp seasoning (powdered), A-one, Vedan, Aji-no-moto, Salsa and Tasty (monosodium glutamate). Research from other scholars, have indicated that the major active ingredients in flavour enhancers are salt (NaCl) and monosodium glutamate (MSG). Other ingredients include: Hydrogenated palm oil, Caramel, Colour, Soyabeans, locust beans, Maltodextrin, Corn starch, Chicken fat, Disodium guanylate, Disodium inosilate, Hydrolyzed plant/Vegetable, protein, Tomatoes, Natural spices e.t.c. (10, 19). Disodium guanylate, disodium inosilate and hydrolyzed plant/Vegetable (functions like MSG).

A Chinese word called umami which means a pleasant savoury taste or delicious taste, is one of the five basic tastes (together with sweet, sour, bitter and salty) (9). People taste umami through receptors for glutamate, which is commonly found in its salt form as the food additive monosodium glutamate (MSG). For that reason, scientists considered umami to be distinct from saltiness (25).

Kikunae Ikeda, a professor and Scientist at the Tokyo Imperial University, first proposed the existence of umami. The term umami was recognized in 1985 to describe the taste of glutamates and nucleotides at the first Umami International Symposium in Hawaii. It represents the taste of the amino acid L-glutamate and 5'-ribonucleotides such as guanosine monophosphate (GMP) and inosine monophosphate (IMP) (20). It can be described as a pleasant "brothy" or "meaty" taste with a long lasting, mouth-watering and coating sensation over the tongue. The sensation of umami is due to the detection of the carboxylate anion of glutamate in specialized receptor cells present on the human and other animal tongues. It enhances the palatability of a wide variety of food. Its effects balance the taste and the overall flavour of the food (3).

Monosodium glutamate is the sodium salt of glutamic acid. It influences the appetite positively as a food additive and induces weight gain. Despite its taste stimulation and improved appetite enhancement, some scholars have indicated that MSG is toxic to humans and experimental animals (4). The sodium content of many seasonings have however, been of great concern because of the link between dietary sodium and hypertension (2). Some food additives that are used as flavour enhancers are: Monoamonium glutamate, Monopotassium glutamate, Monosodium glutamate (MSG), Disodium 5'- inosilate, Cacium glutamate, Disodium 5'-ribonucleotide, Magnesium glutamate, with MSG being used mostly in Nigeria (7).

Glutamate receptors are synaptic receptors that are located on the membranes of neuronal cells (16). They play a central role in excitotoxicity and are implicated in a number of neurological diseases. Prevalence in the central nervous system, it has been linked or speculated to be linked to many neurodegenerative diseases, and several other conditions have been further linked to glutamate receptor gene mutations or receptor auto-antigen /antibody activity.

Testosterone is a hormone in the group of androgens which directly stimulates spermatogenesis through androgen receptors located in the testis (24). The rate or level of spermatogenesis also affects testosterone level and other reproductive hormones. Progesterone is a female sex hormone, synthesized from pregnenolone which in turn is derived from cholesterol. It is among the group of steroid hormones called progestogens. It plays a central role in ovulation, pregnancy, implantation and regulation of uterine functions (12). Estrogens are steroid hormones produced primarily by the ovaries (the granulosa cells of the ovarian follicles and corpora lutea) and placenta (during pregnancy). The ovarian synthesis of estrogen is stimulated by Follicle-stimulating hormone (FSH) (16). The findings from this study, together with related studies using animal models, have exposed the role of most of these seasonings on the weight and serum concentration of sex hormones in wistar albino rats. This present study was aimed at investigate the effects of these seasonings on some sex hormones of male and female wistar albino rats.

II. Methods

Male and female rats of average weight of 104g obtained with approval from the University of PortHarcourt Animal Care Center, were used for this study. Both sex were each grouped into 5 groups comprising of the control (group 1) and 4 treatment groups (group 2-5). Each of these 4 treatment groups consisting of 1mg/g, 2mg/g and 4mg/g body weight represented the 4 seasonings. The animals were housed in cages under standard hygienic condition and were fed with growers mash and water ad libitum and weighed weekly for 3 weeks. For proper observation, 3 animals from each group were sacrificed weekly for 3 weeks. Animals were weighed before the start of administration and weekly before sacrificing them.

Four commonly used seasonings- coded as KC, SMC, BS and IS were purchased from Choba market in PortHarcourt. Each of these seasonings, were weighed and dissolved in warm water. 1mg, 2mg and 4mg of the dissolved samples were orally administered daily for 3 weeks to their various groups of rats.

At the end of the administration period, 3 rats from each group were sacrificed weekly for 3 weeks. Blood samples were taken using a 2ml syringe, collected in blood sample bottles and allowed to coagulate. Serum from coagulated blood samples were centrifuged at 3000 revolution for 10minutes and collected for testosterone, estrogen and progesterone analysis.

Reagents used for analysis where of analytical grade and standard. Serum testosterone, estradiol and progesterone concentrations were analysed using ELISA technique (using Accu-bind ELISA Microwells test system). Where biotinylated antibody, enzyme-antigene conjugate and a serum containing the native antigene, upon mixing in formatted micro plate wells, led to a competitive reaction conjugate for a limited number of antibody binding sites. Absorbance in each well was measured with a spectrophotometer at 450nm (14).

Means and standard deviation (S.D) were calculated for each group of observations. The data obtained were statistically analyzed using ANOVA (SPSS 16.0 Statistical Package of SPSS Inc. USA). Statistical results obtained represents mean ± SD. Means with different superscript letters in each column were significantly different ($P<0.05$) when compared with the corresponding mean of the control.

III. Results

Results for analysis are carried out are presented in Tables 1-8.

Table 1-4 shows the Initial and weekly final body weight of rats in each group when compared with the control. This result revealed a significant percentage increase from week 1-3 for all groups. Rats fed with SMC for 3 weeks had the highest significant dose percentage weight increase, followed by rats fed with IS. The lowest weight significant percentage increase was observed for rats fed with KC (Table 2) when compared with their respective control.

Results from hormonal assay in table 5, shows no significant difference in the mean serum testosterone concentration of the rats fed with IS at all doses when compared with the control. The serum concentration for week 2 was significant only for the highest dose of 4mg (1.00±0.30) when compared with the control (1.56±0.11) at $P<0.05$, while that of week 3 had a dose significant increase at $P<0.05$ from the lowest to the highest dose of IS administered when compared with the control (0.33±0.11). The mean serum estrogen concentration showed a significant increase at all doses when compared with the control groups, though not significant at $P<0.05$ for the lowest dose of 1mg (61.00±2.00). The mean serum progesterone concentration for week 1-3, showed a dose dependent increase at $P<0.05$ for all doses administered from week 1-3.

Table 6 shows the concentration of testosterone, estrogen and progesterone in the serum of rats fed with KC, revealing a significant dose dependent decrease in testosterone concentration in all experimental groups from week 1-3. There was an observed significant increase in estrogen and progesterone concentrations from week 1-3 when compared with the rats in the control group at ($P<0.05$). While table 7 shows the concentrations of these 3 sex hormones in the serum of rats administered BS for three weeks. These rats testosterone concentration had a dose dependent significant decrease from week 1-3 except for the 4mg dose administered in week 3. Estrogen concentration had a dose dependent increase in the serum of the rats, at $P<0.05$ when compared with the control. Progesterone also had a significant dose dependent increase in 2mg and 4mg dose administered for week 1and 3 when compared with the control. While the lowest dose of 1mg (5.23±0.25) for week 2 had no significance at $P<0.05$ when compared with the control.

The mean concentrations of testosterone, progesterone and estrogen in the serum of rats fed with SMC for a duration of 3 weeks is summarized in table 8. From, the result, there was a significant decrease in the concentration of testosterone in week 1 for 1mg and 2mg only. While the decrease in highest dose was not significant at $P<0.05$ when compared with the control. Also in week 2, there was a non significant increase at $P<0.05$ level in the highest dose (0.50±0.31) when compared with the control (1.56±0.11). Estrogen and progesterone concentrations were significantly increased in all experimental groups and at all doses from week 1-3.

IV. Discussion

Monosodium glutamate (MSG) is used extensively throughout the world as a flavour enhancer itself or as an ingredients in the production of other flavour enhancers. Through its stimulation of the sensory receptors, these seasonings- IS, KS, BS and SMC influences the appetite positively and influences weight gain (23). The percentage increase in weight of these rats from the result, shows that the intake of these seasonings can induce an increase in appetite and therefore an increase in weight which can be due to the presence of weight increasing agent such as MSG, salt (which are the main components), hydrogenated fats, disodium inosinate, hydrolyzed vegetable protein (HVP) and starch. Apart from its taste enhancing capabilities, MSG has little or no role it plays in any metabolic functions either as MSG itself or when it dissociates into glutamate component. It is already known that glutamine is a "conditionally essential" nutrient because it is non-essential in normal situations (manufactured by the body in adequate quantities; not required in the diet), unless in conditions of insufficiency (11). Other ingredients contained in these seasonings, have to be put into consideration. The Nacl content of these seasonings is another point of consideration because of the link between excess salt and high blood pressure.

Sodium chloride (NaCl) or salt, is a white crystalline powder or colourless crystals or white pearls, freely soluble in water and practically insoluble in ethanol. It was one of the first nutrients to be identified as essential to life. The body requires little sodium as it is essential in keeping the body's fluid and electrolytes balanced. Sodium (Na) and chlorine (Cl) are rarely found in elemental form in nature; however, most of the toxic effects of NaCl are due to sodium. Chlorine is a major extracellular anion while sodium is a major extracellular cation. The main purpose for addition of salt during food processing is for flavour enhancement, texture and preservation (7).

The hypothalamus of the brain plays a role in the control and synthesis of reproductive hormones. It is the neural control centre for the control of certain hormones including the reproductive hormones. The neuroendocrine activity/ process, are susceptible to changes by some several factors such as hormone administration, nutrition and drugs (22). It is also responsible for certain metabolic process and activities of the

autonomic nervous system. The hypothalamus is interconnected with other parts of the CNS especially the brainstem. It has been reported that, glutamate induces uterine fibroid in rats by increasing the levels of estradiol which was further attributed to MSG and also, reported to be excitotoxic to cells (15).

Excitotoxicity is a process of overstimulation of glutamate receptors which can lead to neuronal damage and neurodegeneration. This process is carried out by excitotoxins. Excitotoxins are amino acids such as glutamate, aspartate and cystein. Which when applied to neurons will cause them to be over stimulated and die. Glutamate is absorbed very quickly in the gastrointestinal tract (GIS) unlike glutamic acid-containing proteins in foods. Absorbed glutamate could spike blood plasma levels of glutamate (13). Its concentrations in plasma are 50–100 μmol/L, in whole brain are 10,000–12,000 μmol/L but only 0.5–2 μmol/L in extracellular fluids (ECFs). The low ECF concentrations, which are essential for optimal brain function, are maintained by neurons, astrocytes, and the blood-brain barrier (BBB) (17).

Estrogens are produced primarily by the ovaries (the granulosa cells of the ovarian follicles and corpora lutea) and placenta (during pregnancy). The ovarian synthesis of estrogen is stimulated by Follicle-stimulating hormone (FSH) which stimulates the ovarian production of estrogens. This synthesis occurs in the granulosa cells of the ovarian follicles (16).

Progesterone is a female sex hormone, synthesized from pregnenolone which in turn is derived from cholesterol. It is among the group of steroid hormones called progestogens. It plays a central role in ovulation, pregnancy, implantation and regulation of uterine functions (12). Progesterone is synthesized from the copus lectum in the ovaries from puberty stage to menopause. While, it is produced in increasing amount in the placenta and ovaries during pregnancy. An increase in progesterone level is stimulated by an increase in luteinising hormone (LH)

The observations from the results of this analysis indicated that the variation in the significance of mean testosterone level in the serum could be that, the duration and dose of SMC administered was not enough to cause any consistent increase in the serum. An increase in the serum progesterone and estrogen could be attributed to the increased in the levels of luteinising hormone and follicle stimulating hormone respectively by SMC. Reports given by Udensi, 2011 and Muhammad, 2014 monosodium glutamate as a widely used food additive and a flavour enhancer in our seasonings and food. There are certain reports about its toxicity. Also, an experimental study by Burde and his group in 1971 reported that, both oral administration and subcutaneous injection of pure MSG to mice resulted in loss of neuronal response in the hypothalamus. This can be a pointer to the fact that a loss in neuronal response of this portion of the brain, can lead to alteration of neuronal control in the secretion of sex hormone through the hypothalamic-pituitary-gonadal regulatory axis (22).

Testosterone is a hormone in the group of androgens which directly stimulates spermatogenesis through androgen receptors located in the testis (24). The rate or level of spermatogenesis also affects testosterone level and other reproductive hormones. (8). About 95% of testosterone is synthesized from the leydig cells of the testes and thus, these cell affect the rate at with spermatogenesis occurs. In mammals, spermatogenesis is totally dependent on testosterone and its stimulation requires direct androgen action (5).

This present study has demonstrated that, the decrease in serum testosterone could be as a result of reduced rate of spermatogenesis in the leydig cells of the testes. While the increase in serum progesterone and estrogen concentrations could be attributed to the increased in the levels of follicle stimulating hormone and luteinising hormone respectively by these seasonings. The observations in correlation to results of previous similar experiments, revealed that MSG, Salt and the presence of other ingredients contained in these seasonings- IS, KC, BS and SMC could alter the rate of secretion and release of these sex hormones from the brain and therefore, affect their serum concentration.

V. Tables For Results

Weigth of Animals

Table 1: The initial and final weight of rats fed with IS for 3 weeks

GROUP/ WEEK	DOSAGE	INITIAL BODY WEIGHT(g)	FINAL BODY WEIGHT(G)	% WEIGHT GAIN
WEEK 1	Control	112.5±7.67	122.5±3.50	10
	1mg	110.3±7.00	122.5±3.53	11
	2mg	112.5±7.89	127.5±3.43	13.3
	4mg	110.0±7.06	130.5±3.57	18.63
WEEK 2	Control	144.33±8.33	158.33±2.88	9.69
	1mg	108.33±4.43	131.67±2.22	21.3
	2mg	105.00±3.22	133.33±2.10	26.98
	4mg	106.67±1.54	138.33±1.98	29.9
WEEK 3	Control	116.67±4.43	143.33±5.77	14.5
	1mg	113.33±1.54	148.33±2.88	30.8
	2mg	108.33±4.73	158.33±2.79	46
	4mg	108.33±4.73	166.67±1.17	51.69

Table 2: Initial and final body weight of rats fed with KC for 3 weeks

GROUP/ WEEK	DOSAGE	INITIAL BODY WEIGHT(g)	FINAL BODY WEIGHT(G)	% WEIGHT GAIN
WEEK 1	Control	112.5±7.67	122.5±3.53	8.88
	1mg	112.5±7.97	122.5±3.33	8.88
	2mg	120±7.06	130.5±3.00	8.75
	4mg	125±7.06	137.5±4.22	10
WEEK 2	Control	144.33±8.33	158.33±2.37	9.69
	1mg	115.47±6.67	136.67±3.10	14.02
	2mg	114.33±7.67	135.67±2.99	19.53
	4mg	104.33±8.95	125.17±2.80	31.34
WEEK 3	Control	116.67±6.43	143.33±5.77	22.85
	1mg	113.33±6.54	146.67±4.88	29.41
	2mg	110.67±6.43	143.33±5.77	30.3
	4mg	108.33±4.43	155±5.00	43.08

Table 3: Initial and Final weight of rats fed with BS for 3 weeks

GROUP/ WEEK	DOSAGE	INITIAL BODY WEIGHT(g)	FINAL BODY WEIGHT(G)	% WEIGHT GAIN
WEEK 1	Control	112.5±17.67	122.5±3.54	8.88
	1mg	110.3±17.00	122.5±3.33	11.06
	2mg	115±17.06	130.0±3.53	17.39
	4mg	110±17.00	137.5±3.53	25
WEEK 2	Control	144.33±8.33	158.33±2.85	9.69
	1mg	115.47±6.67	131.67±2.50	14.02
	2mg	128.86±6.70	152.67±5.50	18.47
	4mg	124.33±8.33	160.33±2.85	28.95
WEEK 3	Control	116.67±14.46	143.33±5.77	22.85
	1mg	108.33±14.76	141.67±2.88	30.77
	2mg	106.67±11.54	145±5.00	38.33
	4mg	108.33±14.43	160.67±5.70	48.31

Table 4: Initial and Final body weight of rats fed with SMC for 3 weeks

GROUP/ WEEK	DOSAGE	INITIAL BODY WEIGHT(g)	FINAL BODY WEIGHT(G)	% WEIGHT GAIN
WEEK 1	Control	144.33±8.30	158.33±2.88	9.69
	1mg	115±13.22	131.67±2.75	16.67
	2mg	108.33±14.43	133.33±2.88	23.07
	4mg	112.67±11.54	146.67±5.00	30.17
WEEK 2	Control	144.33±8.03	158.33±2.75	9.69
	1mg	108.33±14.43	133.33±2.88	23.07
	2mg	106.67±11.70	136.67±5.78	28.12
	4mg	110±13.22	150.67±2.89	36.97
WEEK 3	Control	116.67±14.60	143.33±5.77	22.85
	1mg	108.33±14.76	146.67±2.89	35.39
	2mg	115.67±14.46	163.67±5.77	41.49
	4mg	106.67±11.51	165±5.00	54.68

VI. Hormonal Assay

Results of assay of reproductive hormones in rats fed with these seasonings and their control are as presented in tables 5-8.

Table 5: The mean serum reproductive hormone concentration in both male and Female rats that received varied doses of IS each for 3 weeks.

Parameters	Groups	Week 1	Week 2	Week3
Testosterone (male) (nm/L)	Control	1.50 ± 0.07^{a}	1.56 ± 0.11^{a}	0.33 ± 0.11^{a}
	1mg	2.36 ± 0.17^{a}	1.80 ± 0.25^{a}	1.66 ± 0.35^{b}
	2mg	2.20 ± 0.30^{a}	1.65 ± 0.26^{a}	1.26 ± 0.15^{b}
	4mg	1.56 ± 0.14^{a}	1.00 ± 0.30^{b}	0.73 ± 0.18^{b}
Estrogen (fem)	Control	58.00 ± 1.41^{a}	59.33 ± 2.51^{a}	60.66 ± 1.52^{a}
	1mg	25.00 ± 2.82^{b}	30.66 ± 2.08^{b}	61.00 ± 2.00^{a}
	2mg	38.00 ± 1.45^{b}	43.33 ± 1.52^{b}	78.66 ± 2.51^{b}
	4mg	44.50 ± 0.70^{b}	51.67 ± 1.15^{b}	98.00 ± 2.10^{b}
Progesterone (fem)	Control	5.70 ± 0.14^{a}	5.73 ± 0.11^{a}	6.06 ± 0.25^{a}
	1mg	12.30 ± 0.42^{b}	8.26 ± 0.30^{b}	15.40 ± 0.36^{b}
	2mg	15.45 ± 0.35^{b}	12.43 ± 0.45^{b}	17.46 ± 0.75^{b}
	4mg	20.20 ± 0.28^{b}	15.50 ± 0.20^{b}	22.63 ± 0.25^{b}

Results represents mean ± SD. Means with different superscript letters in each column are

Significantly different (P<0.05) compared with the corresponding mean of the control

Table 6: The mean serum reproductive hormone concentration in both male and Female rats that received varied doses of KC each for 3 weeks

PARAMETERS	GROUPS	WEEK 1	WEEK 2	WEEK 3
TESTOSTERONE (MALE) (nmol/L)	Control	1.50±0.07[a]	1.56±0.11[a]	0.33±0.11[a]
	1mg	3.13±0.05[b]	1.05±0.20[b]	1.20±0.15[b]
	2mg	2.13±0.14[b]	0.93±0.30[b]	0.90±0.25[b]
	4mg	1.06±0.19[b]	0.53±0.41[b]	0.23±0.20[b]
ESTROGEN (FEMALE) (nmol/L)	Control	58.00±1.41[a]	59.33±2.51[a]	60.66±1.52[a]
	1mg	21.50±2.12[b]	45.33±2.08[b]	84.67±2.52[b]
	2mg	72.00±1.45[b]	68.33±1.52[b]	72.55±2.08[b]
	4mg	91.50±2.12[b]	83.00±2.00[b]	90.05±2.51[b]
PROGESTERONE (FEMALE) (nmol/L)	Control	5.70±0.14[a]	5.73±0.11[a]	6.06±0.25[a]
	1mg	8.30±0.42[b]	10.16±0.37[b]	10.53±0.47[b]
	2mg	10.40±0.28[b]	17.60±0.40[b]	15.86±0.15[b]
	4mg	15.30±0.30[b]	19.66±0.20[b]	31.63±0.31[b]

Results represents mean ± SD. Means with different superscript letters in each column are Significantly different (P<0.05) compared with the corresponding mean of the control

Table 7: Mean serum reproductive hormone concentration in both male and female rats that received varied doses of BS each for 3 weeks

PARAMETERS	GROUPS	WEEK 1	WEEK 2	WEEK 3
TESTOSTERONE (MALE)	Control	1.50±0.07[a]	1.56±0.11[a]	0.33±0.11[a]
	1mg	1.25±0.14[b]	0.80±0.12[b]	1.30±0.05[b]
	2mg	0.90±0.24[b]	0.70±0.15[b]	0.16±0.20[b]
	4mg	0.70±0.21[b]	0.36±0.20[b]	0.36±0.10[a]
ESTROGEN (FEMALE)	Control	58.00±1.41[a]	59.33±2.51[a]	60.67±1.52[a]
	1mg	10.00±3.53[b]	12.33±2.52[b]	81.03±3.05[b]
	2mg	22.50±3.45[b]	20.67±2.08[b]	71.95±2.08[b]
	4mg	41.50±2.12[b]	36.66±3.05[b]	75.04±2.11[b]
PROGESTERONE (FEMALE)	Control	5.70±0.141[a]	5.73±0.11[a]	6.06±0.25[a]
	1mg	7.30±0.29[b]	5.23±0.25[a]	8.23±0.31[b]
	2mg	19.80±0.11[b]	10.47±0.15[b]	22.36±0.30[b]
	4mg	30.20±0.28[b]	20.36±0.31[b]	26.33±0.20[b]

Results represents mean ± SD. Means with different superscript letters in each column are Significantly different (P<0.05) compared with the corresponding mean of the control.

Table 8: Mean serum reproductive hormone concentration in both male and female Rats that received varied doses SMC each for 3 weeks

PARAMETERS	GROUPS	WEEK 1	WEEK 2	WEEK 3
TESTOSTERONE (MALE)	Control	1.50±0.07[a]	1.56±0.11[a]	0.33±0.11[a]
	1mg	1.86±0.14[b]	1.50±0.21[b]	1.25±0.07[a]
	2mg	0.90±0.12[b]	0.76±0.15[b]	0.66±0.15[b]
	4mg	0.70±0.21[a]	0.50±0.31[a]	0.23±0.26[b]
ESTROGEN (FEMALE)	Control	58.00±1.41[a]	59.33±2.52[a]	60.66±1.52$_a$
	1mg	40.50±2.12[b]	35.33±3.05[b]	64.66±2.08$_a$
	2mg	47.50±0.70[b]	43.33±2.51[b]	83.67±2.10$_b$
	4mg	52.00±1.10[b]	50.67±1.53[b]	91.18±3.00[b]
PROGESTERONE (FEMALE)	Control	5.70±0.14[a]	5.73±0.11[a]	6.06±0.25[a]
	1mg	12.35±0.49[b]	10.73±0.15[b]	17.46±0.30[b]
	2mg	15.20±0.28[b]	13.43±0.20[b]	22.56±0.21[b]
	4mg	17.65±0.35[b]	15.13±0.21[b]	32.93±0.15[b]

Results represents mean ± SD. Means with different superscript letters in each column are Significantly different (P<0.05) compared with the corresponding mean of the control.

VII. Conclusion

In Nigeria, industrially produced and imported seasonings are the key to cooking and a dish never seems to be complete without one or more of these seasonings added to it. This has lead to their rise in production, sales and demand. The results of this present investigation have shown with evidence that components of these food seasonings are capable of producing alterations (either increasing or decreasing) in the body weight and some sex hormones of wistar albino rats.

The understanding of the effects of the contents of these food seasonings, the mechanism in which they alter weight and some sex hormones, creates awareness on what their effects can have on wistar albino rats.

Most of these effects can also occur in humans, which can be as a result of their accumulation in the human body over a period of time which may not be immediate. Salt and monosodium glutamate (flavour enhancer) amongst other components such as Corn starch, Hydrogenated palm oil, Caramel, Colour, Soyabeans, locust beans, Hydrolyzed plant/ Vegetable protein, Tomatoes, Natural spices, Maltodextrin, Chicken fat e.t.c. are contained in these seasonings. In conclusion, the components in these seasonings may be capable of having adverse effects on the body system despite their roles as flavour and taste enhancers. The results obtained from this correlates with similar experimental works by other scholars, which revealed that the effects of these seasonings were dose dependent as the higher dose had more significant increase or decrease in weight.

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