

EFFECTS OF THE INGESTION OF *MICROWAVED* FOOD ITEMS ON SOME HAEMATOLOGICAL PARAMETERS IN ALBINO WISTAR RATS.

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Authors' contributions

Author BCE designed the study, collected and prepared the samples, participated in the laboratory procedures and wrote the first draft of the manuscript. Author NNJ supervised the design and analysis of the study. Author BCA, Author CEO and Author ECM participated in the literature searches and analysis of the study. All authors read and approved the final manuscript.

ABSTRACT

Aim: To determine if there is a correlation between the ingestion of *microwaved* food items and haematological parameters.

Study Design: Twenty male albino rats weighing between 180-200g were used for the study and randomly assigned into 2 study groups of 10 animals each. **The animals were 10 – 11 weeks old on arrival.**

Place and Duration of Study: Federal University of Technology, Owerri, Nigeria, between September 2013 and December 2013.

Methodology: Group 2 animals were fed on *microwaved* food items **such as boiled rice and stew, jollof rice, porridge beans, porridge yam and boiled fish** while group 1 animals were fed on similar *unmicrowaved* food items for 3 months. **All food items spent only 4 minutes in the microwave oven.** Blood samples of the 2 groups were analyzed in the laboratory.

Results: A significant decrease in the means of Red Blood Cell ($769.0 \times 10^4 \pm 15.36$ to $683.6 \times 10^4 \pm 13.41$), White Blood Cell ($8.52 \times 10^3 \pm 1.15$ to $5.98 \times 10^3 \pm 0.96$), Packed Cell Volume (45.28 ± 1.03 to 34.20 ± 1.93), Haemoglobin Concentration (19.18 ± 0.37 to 15.56 ± 0.35), Lymphocytes (72.75 ± 0.99 to 53.70 ± 0.96), monocytes (6.47 ± 0.27 to 5.60 ± 0.36) and eosinophils (3.90 ± 0.20 to 2.64 ± 0.47) counts of group 2 animals was shown when compared to group 1 animals ($P = .05$). A significant increase in the mean of neutrophils (35.50 ± 0.85 to 42.84 ± 0.68) count of group 2 animals was shown when compared to group 1 animals ($P = .05$). There was no significant decrease in basophils (1.60 ± 0.37 to 1.42 ± 0.65) count of group 2 animals when compared to group 1 animals ($P = .05$).

Conclusion: These results suggest that the ingestion of *microwaved* food items affects some haematological parameters.

Keywords: Albino wistar rats; **differential white blood cell count**; haematological parameters; microwave.

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1. INTRODUCTION

Microwaves which are like light waves or radio waves occupy a part of the electromagnetic spectrum of energy, they are very short waves and travel at the speed of light (3×10^8 m/s). Microwaves are essentially used for cooking foods at a frequency of 2450×10^6 Hz [1]. Radiation is energy that comes from a source and travels through space and may be able to penetrate various materials.

Radiation can cause ionization which is what takes place when a neutral atom gains or loses electrons. Non-Ionizing radiation (NIR) refers to radiative energy that, instead of producing charged ions when passing through matter, has sufficient energy only for excitation. Nevertheless, it is known to cause biological effects [2]. The ability of NIR to penetrate an object and the subsequent effects are very much frequency dependant. Near ultraviolet, visible light, infrared, microwave, radio waves and low-frequency radio frequency are all examples of non-ionizing radiation. By contrast, far ultraviolet light, x-rays, gamma-rays and all particle radiation from radioactive decay are regarded as ionizing. Traditional sources of cooking heat use waves of infrared frequency to heat food, either directly as in grilling or broiling or indirectly, where the fire heats the pot and the pot, by direct contact, heats the food. Infrared frequency (what we normally refer to as heat) cooks the food relatively gently, actually shaking its molecules in a more or less agitated way, according to the degree of heat applied.

Microwave ovens are different. The alternating microwave electric current generated by the magnetron in every microwave oven forces the food molecules to rotate at the frequency of 1-100 billion times per second. The friction from this violent, thrashing motion tears at the food, vitamin and enzyme molecules, destroying, for instance, their cells' walls, while heating them savagely and changing their shape [3]. Besides, no indirect heating of pots or plates is possible because hard materials resist rotation of their molecules. The pot or plate is only heated from direct contact with the heated *microwaved* food. A microwave oven changes the molecular structure of the food by the process of radiation with the use of a tube called magnetron which converts electrical energy to microwave energy. Microwaving causes adverse effects in foods which include the destruction of nutrients [4]. Microwave cooking is rapid and this is achieved by passing high frequency waves from a magnetic iron through the food or liquid to be heated. Water absorbs microwave energy very well, so foods with high water content cook more rapidly. On the other hand, fat absorbs microwave energy more slowly, so foods consisting of mixture of fat and water cook unevenly. *Microwaved* foods contain deformed molecules not present in foods cooked conventionally [1]. Naturally occurring amino acids have been observed to undergo isomeric changes as well as transformation into toxic forms, under the impact of microwaves produced in ovens [5]. Haematological parameters have been associated with health indices and are of diagnostic significance in routine clinical evaluation of the state of health [6]. The blood is a vital fluid, which contains the Red Blood Cell (RBC), White Blood Cell (WBC) and platelets suspended in the serum in homeostatic concentrations. The circulatory blood volume makes up about 8% of the weight of an average man. The blood cells take up about 45% of the blood while plasma constitutes about 55% [7]. The Packed Cell Volume (PCV) measures the percentage by volume of packed RBC in a whole blood sample after centrifugation. The Haemoglobin Concentration (Hb Conc.) measures the amount of Hb in grams in 1 dl of whole blood and provides an estimate of oxygen carrying capacity of the RBC. The blood differential test measures the percentage of each type of WBC in the blood. White blood cell differentials are indicators of the ability of an organism to eliminate infection. Ingestion of food cooked in a microwave oven causes abnormal changes in the blood and physiology of humans. These changes include a decrease in all haemoglobin and cholesterol values especially the ratio of the High-Density Lipo-protein (HDL - good cholesterol) and the Low-Density Lipo-protein (LDL - bad cholesterol) values [5]. Lymphocytes show a more distinct short term decrease [8]. Each of these indicators points at degeneration. Since we are what we eat, the creation of abnormalities in our food creates abnormalities in us. Though the biological hazards associated with microwave cooking have been reported, laboratory measurements to ascertain if there is a correlation between the ingestion of *microwaved* food items and haematological parameters, using albino wistar rat specimens, are paramount. The present study is considered significant because knowledge of any possible correlation will help to assess how much harm modern cooking facilities such as the microwave oven has caused.

The objective of this work was essentially to determine if there is a correlation between the ingestion of *microwaved* food items and haematological parameters.

2. MATERIALS AND METHODS

2.1 Experimental Design

Twenty male albino wistar rats weighing between 180-200g were obtained from the Department of Veterinary Medicine, University of Nigeria. All animals were 10 - 11 weeks old and clinically normal on arrival. They were acclimatized for two weeks, during which they were placed on standard diet (Top Feed). The animals were kept in a laboratory under controlled light and at the temperature range of 20°C – 24°C. Subsequently, the rats were divided into 2 groups. The exposed group were fed on *microwaved* food items such as boiled rice and stew, jollof rice, porridge beans, porridge yam and boiled fish while the control group were fed on similar *unmicrowaved* food items. All food items spent only 4 minutes in the microwave oven. The microwave oven used in this study was the DAEWOO oven with model number KOG-6C2B; its power input was 1200W while the power output was 800W. After 3 months of feeding, the animals from each group were anaesthetised using chloroform and blood obtained by cardiac puncture for analysis. All animal procedures were in strict accordance with the NIH Guide for the Care and Use of Laboratory Animals.

2.2 Haematological Estimations

The blood samples collected into Ethyl Diathamine (EDTA) bottles were used immediately for the determination of haematological parameters. The Neubauer counting chamber was used in RBC count after the addition of RBC diluting fluid as described by [9]. The Neubauer counting chamber was used in WBC count after the addition of Turk solution as described by [9]. The PCV was determined by centrifuging heparinized blood sample in a capillary tube (microhaematocrit tube) as described by [10]. The spectrophotometer was used in Haemoglobin concentration count after the addition of Drabkin Solution as described by [10]. The differential white blood cell was counted manually after smearing the Leishman's stained drop of blood onto a glass slide as described by [11].

3. RESULTS AND DISCUSSION

This study is aimed at evaluating the effects of the ingestion of *microwaved* foods on haematological parameters such as RBC and WBC counts, PCV, Hb concentration and differential WBC counts. Table (1) shows the RBC Count, WBC Count, PCV and Hb concentration of rat specimens. The significant decrease ($P = .05$) in RBC count in the exposed group may be due to failure of erythropoietin production [12]. This could lead to anaemia. The PCV also known as haematocrit represents the percentage of RBC in blood. There is a direct relationship between RBC, PCV and Hb concentration [13]. Hence, a decrease in one parameter results in a decrease in others. This result agrees with the findings of [14] whose study on the effect of microwave exposed mice feed on the haematological parameters of Swiss albino mice showed a significant decrease in RBC, PCV and Haemoglobin concentration at all autopsy intervals and at the microwave power of 320W and exposure time of 10 minutes. The WBC count also decreased significantly ($P = .05$) in the exposed group. This may be related to the destruction of nutritive value of *microwaved* food items. Table (2) shows the Neutrophils, Lymphocytes, Basophils, Monocytes and Eosinophils counts. The significant decrease ($P = .05$) in lymphocytes, monocytes and eosinophils counts of group 2 may equally be related to the destruction of nutritive value of *microwaved* food items. However, the significant increase ($P = .05$) in neutrophils count, the most abundant of any of the white blood cells, in group 2 indicates physical stress. Besides, there is no significant decrease ($P = .05$) in basophils count in the exposed group when compared to the control group. Normal basophils levels generally vary from 0-2% of the existing white blood cells and basophils is the least common of all white blood cells.

Table 1: Haematological indices of rats

Group	RBC Count per mm ³ blood (N×10 ⁴ cells)	WBC Count per mm ³ blood (N×10 ³ cells)	PCV (%)	Hb Conc. (g/dl)
1 (Control)	769.0±15.36	8.52±1.15	45.28±1.03	19.18±0.37
2 (Exposed)	683.6± 13.41	5.98±0.96	34.20±1.93	15.56±0.35

*Mean±SD, **P = .05, ***n = 10, ****T = 20

Table 2: Differential white blood cell count of rats

Group	Neutrophils (%)	Lymphocytes (%)	Basophils (%)	Monocytes (%)	Eosinophils (%)
1 (Control)	35.50±0.85	72.75±0.99	1.60±0.37	6.47±0.27	3.90±0.20
2 (Exposed)	42.84±0.68	53.70±0.96	1.42±0.65	5.60±0.36	2.64±0.47

*Mean±SD, **P = .05, ***n = 10, ****T = 20

* Means and standard deviations are reported in Tables 1 and 2.

** Level of significance.

*** Number of animals per group.

**** Total number of animals used.

4. CONCLUSION

The study has shown the effects of the ingestion of *microwaved* food items on some haematological parameters such as RBC, WBC, PCV, Haemoglobin concentration and differential white blood cell. The *microwaved* food items ingested by albino wistar rats have adversely affected some haematological parameters. Such effects could lead to anaemia, malnutrition and excessive stress on cells.

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