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# Meat qualities of rabbits fed diets containing dried watermelon rinds as an energy source

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## Abstract

*The silent competition between humans and livestock for maize has brought about the recent researches on the use of unconventional feed ingredients, such as dried water melon rinds (DWMR), as an inclusion in livestock feed. This study was therefore conducted to assess the effect of diets containing graded levels of DWMR on rabbits' meat quality. Eighty (80) crossbreed, unsexed weaner rabbits with the mean weight of 630g were used for this study, allocated on weight equalization basis into four (4) treatment groups (0%, 5%, 10% and 15% of DWMR inclusion levels, representing T1, T2, T3 and T4 respectively and further divided into five (5) replicates of 4 rabbits. A total of 24 rabbits, 6 from each treatment were slaughtered for meat quality assessment. Results revealed a significant (P<0.05) influence of DWMR in the fat and crude fibre (within the negligible range of 1-2%) contents of the meat. Fat was highest (14.21%) in T3 while fibre was highest (1.11%) in T4. Cooking loss, refrigeration loss, water absorptive power and colour of meat from rabbits were not significantly (P>0.05) affected by DWMR. Although lipid profile was not significantly (P>0.05) affected by DWMR, significant (P<0.05) differences were observed in the levels of Malondialdehyde (MDA), Gluthatione (GSH) and Catalase (CAT). MDA level was least at the 5% DWMR treatment group while the 0% and 10% DWMR treatment groups had the highest level of GSH and CAT respectively. Meat from rabbits fed 15% DWMR recorded the highest score for tenderness in sensorial profile. It was then concluded that up to 15 % of DWMR in rabbits' diets had no negative effect on the quality of their meat.*

***Keywords:*** *Rabbit; Watermelon rinds; Maize; Meat quality; Energy source*

## Introduction

Rabbits (*Oryctolagus cuniculus*) are described as sensitive micro-livestock species that has been researched to be the most affordable and viable means of producing animal protein in a developing country like Nigeria. Ajala and Balogun, (2004) reported on a convenient way of solving animal protein deficiency in Nigeria, and they opinionated that rabbit production was a solution. Rabbit meat offers excellent returns on investment, premium meat products, a high protein content of approximately 20.8%, low levels of fat, cholesterol, and sodium, and it compares favorably to the local bush meat. However, the quality of rabbit meat is affected by a lot of factors which include nutrition, housing and climate. In order to reduce the rising cost of animal feed, it is necessary to find affordable, readily available, and ready-to-use alternative feedstuffs for rabbits (Ewa *et al.,* 2019). Non-conventional feed ingredients like crop residues and agro-industrial by-products, such as watermelon (*Citrullus lanatus*) rind, that are not consumed by humans could be used as alternatives in rabbits' diets because they are efficient converter of fibrous feed ingredients and agro-industrial by-products to meat than other livestock species (Ajagbe *et al*., 2022). Rinds from watermelons are said to be abundant in Nigeria wherein they contain micronutrients that include carotene, vitamin K, ascorbic acid, riboflavin, iron, iodine, and other mineral components in high concentrations (Zhao *et al*., 2013). Watermelon rind possesses significant amounts of moisture (10.61%), ash (13.09%), crude protein (11.17%), fat (2.44%), and carbohydrates (56%) (Al-Sayed and Ahmed, 2013). It has been shown to contain citrulline which produces arginine, which the body uses to generate proteins and contributes to blood vessel relaxation, (Lius, 2003). Hence, the rinds of watermelon can be fed to animals such as rabbits and grasscutter because of their rapid growth and capacity to transform agricultural waste and tropical forages into meat for human use. The term used to describe the overall meat characteristics including its physical, chemical, morphological, biochemical, microbial, sensory, technological, hygienic, nutritional and culinary properties is known as meat quality (Guzek *et al*., 2013). Nutrition of rabbits has a significant impact on rabbit meat quality and safety. Consumers, with increasing health consciousness, are becoming more aware of the nutritional value of the foods they eat. In view of this, there is need to investigate the nutritional meat qualities of rabbit fed diets containing dried watermelon rinds as an energy source. There have been studies on effect of watermelon rinds on the nutrient composition, performance and carcass characteristics of albino rats and broiler chickens (Okai *et al*. 2009; Otu *et al*. 2021); Osman *et al.* (2019) reported that the supplementation of 10% watermelon rinds in the diet of weaner rabbits had a greater carcass weight and dressing percentage, but there is no information on its meat qualities. Hence, this research assessed the sensorial profile, cooking loss, refrigeration loss, colour intensities, lipid profile, proximate composition, Malondialdehyde (MDA) and antioxidant status of meat from rabbits fed diets containing dried watermelon rinds.

## Materials and Methods

### Experimental site, animals, design, and diets

The rearing aspect of the experiment was carried out at the Rabbitry unit of the Directorate of University Farms (DUFARMS) while the meat qualities were carried out at the Animal Products and Processing Laboratory, Animal Production and Health department, College of Animal science and Livestock production, Federal University of Agriculture, Abeokuta, Ogun state, Nigeria.

Fresh watermelon rinds were collected from fruit vendors around Alabata axis, Odeda Local Government Area, Abeokuta, Ogun state, Nigeria. The rinds were rinsed thoroughly and scrapped to remove sand particles and watermelon remains that might cause decaying instead of drying. The rinds were then sliced into smaller sizes and sundried for about 3 weeks. During sun drying, the rinds were continuously turned to ensure uniform drying. After which it was then milled with hammer mill (Peruzzo®) into smaller sizes of 2mm and incorporated into the diets of the experimental animals (80 crossbreed, unsexed weaner rabbits within the weight range of 630g) at 0, 5, 10 and 15 % levels as shown in Table 1. The experimental animals were weighed and allocated on the basis of weight equalization into four (4) dietary treatments *i.e.;*(0%, 5%, 10% and 15% of dried watermelon rinds inclusion levels, and this represents T1, T2, T3 and T4 respectively). Each treatment group containing 20 rabbits, further replicated five (5) times with each replicate containing 4 rabbits. The rabbits were kept in hutches equipped with concrete feeders and drinkers, used to feed and provide water for them *ad-libitum*. Maintenance of strict hygiene like daily sweeping of the pen, washing and refilling of drinkers with fresh clean water, cleaning of feeders and provision of feed was thoroughly ensured throughout the period of experiment (14 weeks).

**Meat quality assessment**

The Longissimus thoracis et lumborum (LTL) muscle of 6 rabbits per dietary treatment was removed from both the left and right sides of the carcasses. The cranial portion of the left LTL muscle was used to measure the colour of the meat. The fore part was used for thiobarbituric acid-reactive substance (TBARS) analysis. The hind part was used to measure thawing and cooking losses.

**Colour measurements**

Meat colour was measured for the LTL muscle using a Minolta colorimeter (model CR300, Konica Minolta, Ramsey, NJ) that was standardized with a white calibration plate (illuminate C readings of Y= 92.8; x = 0.3134; y= 0.3197). Colour will be Measured using the C.I.E. L*a*b* colour scale, the colour values will be expressed as L* (lightness), a* (redness/greenness) and b* (yellowness/blueness) according to Hunt (1991).

**Nutrient composition**

The moisture, crude protein, crude ash and crude fat contents of thigh muscle was analysed according to AOAC (2000). The contents of calcium and iron were measured using flame atomic spectrophotometry. Calcium was determined at ë = 442.7 nm and iron was determined at ë = 248.3nm using the method described by AOAC (2000).

**Cooking loss**

The weight of each sample was taken before and after cooking to determine cooking loss, which is defined as the cooked weight divided by uncooked weight multiplied by 100. The following formula was used:

Cooking loss (g) = Weight of raw meat – Weight of cooked meat

Cooking loss (%) = Weight of raw meat – Weight of cooked meat x 100/ Weight of raw meat

**Refrigeration loss**

Meat samples weighing 50g were obtained from the hind limb before refrigeration and re-weighed after 48 hours to determine the refrigeration loss.

Refrigeration Loss (g) = Weight of sample before refrigeration - weight after refrigeration

**Water absorptive power**

3g of meat samples from breast muscles was collected and placed in clean labelled test tubes, 10mL of distilled water was added to each test tube, each sample was totally submerged in distilled water and left for an hour. After which, the samples were removed and reweighed. The increase in weight of the sample indicates the volume of water absorbed.

**Lipid profile determination**

Composite paste of the hindlimb muscle was prepared with a known amount of chloroform and methanol mixture 1: 1 (v/v) for each replicate. The resulting paste solvent mixture was filtered and rinsed with an additional volume of the combined homogenate and allowed to stand for five minutes. The filtered homogenate was equilibrated to remove non lipid material, 2% (0.32M) w/v KCl. solution was added to the aqueous layer (Folch *et al*., 1957). The filtrate was centrifuged and lipid extract was decanted. The extract was made up to a final volume by adding chloroform, which was decanted, and the mixture obtained was used for the determination of meat cholesterol, triglycerol and high- and low-density lipoprotein values respectively.

**MDA determination using 2 - Thiobarbituric Acid Reactive substance**

Each meat sample (5 g) from the hindlimb muscle of each replicate was homogenised in 15 ml of distilled water. Sample homogenate (5 ml) was transferred to a test tube and lipid oxidation was determined as the 2-thiobarbituric acid reactive substance (TBARS) value by method described by Ahn *et al*., 1998. Lipid oxidation was reported as milligrams of malondialdehyde per kilogram of meat (Jang *et al*., 2007).

**Superoxide dismutase (SOD)**

The activity of SOD was measured by the xanthine oxidase method (ELISA Kit: Cayman Chemical Company, USA, Catalog No. 706002), which monitors the inhibition of nitro blue tetrazolium reduction by the hindlimb meat sample as described by Sun *et al*. (1988). The protein concentrations in muscle were quantitated by the bicinchonibate (BCA) method, using a protein assay kit (Bio-Rad, Hercules, CA, USA).

**Sensory evaluation**

Samples from the hindlimb muscle were collected and washed in clean water, packed in a transparent polythene bag and labelled for identification. They were boiled at 70 $^0$C in water for 15minutes, allowed to cool under room temperature and served to panellists. Ten experienced panellists were used for the sensory evaluation. Bite size portions of boiled meat samples from the breast meat weighing about 10g were served at room temperature to the trained panellists. Each panellist was required to masticate one sample per treatment and ranked preferences in the following categories: colour, juiciness, meaty, flavour, tenderness, saltiness, overall flavour and overall acceptability and then awarded scores using a 9-point hedonic scale (1 = Dislike extremely, 2 = Dislike very much, 3 = Dislike moderately, 4 = Dislike slightly, 5 = Intermediate, 6 = Like slightly, 7 = Like moderately, 8 = Like very much, 9 = Like extremely (Sanwo *et al*., 2011).

**Statistical analysis**

Data obtained were subjected to a One-Way Analysis of Variance using the generalized linear model procedure of Statistical Package for Social Sciences version 21 (SPSS, 2012). Data obtained from sensory experiments were subjected to Linear Mixed Model with panelists' effect blocked following GLM procedure of the same statistical package. The significant differences among the treatment means were separated using Duncan's Multiple Range Test as contained in the same statistical package.

**Table 1: Percentage Composition of Experimental Diets**

| | T1 | T2 | T3 | T4 |
|---|---|---|---|---|
| Level of Inclusion of DWMR (%w/w) | | | | |
| Ingredients | 0 | 5 | 10 | 15 |
| Maize | 45 | 40 | 35 | 30 |
| Palm Kernel Cake | 10 | 10 | 10 | 10 |
| Soya bean meal | 10 | 10 | 10 | 10 |
| DWMR | 0 | 5 | 10 | 15 |
| Wheat offal | 30 | 30 | 30 | 30 |
| Bone meal | 3 | 3 | 3 | 3 |
| Oyster shell | 1.50 | 1.50 | 1.50 | 1.50 |
| Salt | 0.25 | 0.25 | 0.25 | 0.25 |
| Vitamin Premix | 0.25 | 0.25 | 0.25 | 0.25 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 |
| **Calculated Analysis** | | | | |
| Metabolizable Energy (MJ/kg) | 2611.4 | 2439.8 | 2268.2 | 2096.6 |
| Crude protein (%) | 15.39 | 15.55 | 15.72 | 15.89 |
| Crude fibre (%) | 5.52 | 6.16 | 6.80 | 7.44 |

DWMR: Dry Water Melon Rind

## Results

Physico-chemical meat qualities of rabbits fed diets containing graded levels of dried watermelon rinds is depicted in Table 2. Dried watermelon rinds had no significant ($p > 0.05$) effect on the cooking loss, refrigeration loss, colour and water absorptive power of rabbit meat. Samples of meat from rabbits fed diets containing 15% dried watermelon rinds had the lowest mean values for refrigeration (0.67 %) and cooking losses (13.43 %). The highest mean value (19.11 %) for water absorptive power was observed in the treatment group that contained meat samples from rabbits fed 0% inclusion of dried watermelon rinds in their diets while the least mean score (15.19 %) was noticed from the experimental animals fed 5% diets inclusion of dried watermelon rinds.

**Table 2: Physico-chemical meat qualities of rabbits fed diets containing dried watermelon rind**

| | Inclusion Levels of DWMR (%) | | | | |
|---|---|---|---|---|---|
| Parameters | 0 | 5 | 10 | 15 | SEM |
| Water absorptive power (%) | 19.11 | 15.19 | 17.89 | 17.08 | 0.77 |
| Cooking loss (%) | 13.53 | 13.94 | 14.04 | 13.43 | 0.62 |
| Refrigeration loss (%) | 0.79 | 1.41 | 3.70 | 0.35 | 0.70 |
| L* | 34.38 | 37.06 | 34.78 | 35.70 | 0.52 |
| a* | 9.37 | 9.46 | 10.17 | 9.56 | 0.25 |
| b* | 4.36 | 5.06 | 4.41 | 4.36 | 0.27 |

[abcd] *Means along the row without superscripts are not significantly (p>0.05) different*
DWMR - Dried Watermelon Rinds L* - Lightness intensity
SEM – Standard Error of Mean a* - redness intensity b* - yellowness intensity

Table 3 presents the nutrient composition of meats from rabbits' diets containing dried watermelon rinds (DWMR). The proximate composition showed significant ($p<0.05$) differences only in fat and fibre contents. Fat content was observed to be highest ($p<0.05$) in the meats of the rabbits fed 10% DWMR diet but lowest in the 15% DWMR dietary group. Conversely, meats from rabbits fed diet containing 15% DWMR recorded the highest ($p<0.05$) value (1.11%) for fibre while those in the 10% DWMR dietary group recorded the least fibre content (0.58%), meat samples from both 0% and 5% dietary group had comparative values (0.81% and 0.89% respectively).

The result of the lipid profile of meats from rabbits fed diets containing DWMR is shown on Table 4. The results revealed that the inclusion of DWMR had no significant ($p>0.005$) influence on all the parameters.

**Table 3. Nutrient composition of meat from rabbits fed diets containing dried watermelon rind**

| | Inclusion level of DWMR (%) | | | | |
|---|---|---|---|---|---|
| Parameters (%) | 0 | 5 | 10 | 15% | SEM |
| Moisture | 53.18 | 52.04 | 51.36 | 52.72 | 0.60 |
| Fat | $12.75^{ab}$ | $12.68^{ab}$ | $14.21^{a}$ | $11.48^{b}$ | 0.39 |
| Ash | 1.79 | 1.57 | 1.65 | 1.70 | 0.94 |
| Fibre | $0.81^{ab}$ | $0.89^{ab}$ | $0.58^{b}$ | $1.11^{a}$ | 0.08 |
| Protein | 20.48 | 18.67 | 19.87 | 20.26 | 0.81 |
| Carbohydrate | 11.00 | 14.16 | 12.32 | 12.54 | 0.64 |

[ab] *Means along the row with different superscripts are significantly (p<0.05) different*.
DWMR - Dried Watermelon Rind
SEM – Standard error of mean

**Table 4: Lipid profile of meat from rabbits fed diets containing dried watermelon rind**

| | Inclusion level of DWMR (%) | | | | |
|---|---|---|---|---|---|
| **Parameters** | 0 | 5 | 10% | 15 | SEM |
| Total Cholesterol | 95.12 | 95.37 | 105.92 | 113.05 | 5.11 |
| Triglyceride | 84.70 | 91.72 | 102.12 | 91.93 | 2.94 |
| Very Low Density Lipoprotein | 16.95 | 18.37 | 20.45 | 18.40 | 0.59 |
| High Density Lipoprotein | 47.57 | 47.68 | 52.95 | 56.52 | 2.56 |
| Low Density Lipoprotein | 30.62 | 29.37 | 32.52 | 38.13 | 2.62 |

DWMR - Dried Watermelon Rind
SEM – Standard error of mean

Table 5 shows the effect of Malondialdehyde (MDA) on rabbit meat. The study found that varying levels of dried watermelon rinds (DWMR) in rabbit diets significantly ($p<0.05$) influenced key oxidative stress markers and antioxidant enzymes in the meat. The 0% DWMR group had the highest malondialdehyde (MDA) level (2.21 MM/L), significantly higher than the 5% DWMR group (1.04 MM/L). Glutathione (GSH) was highest in the 0% DWMR group (16.40 U/L) and significantly lower in the 10% (12.33 U/L) and 15% (12.08 U/L) groups. Catalase (CAT) activity was significantly higher in the 10% DWMR group (0.27 U/L) compared to the 0% group (0.10 U/L).

**Table 5: MDA and antioxidant status of meats from rabbits fed diets containing dried watermelon rind**

| Inclusion level of DWMR (%) | | | | | |
|---|---|---|---|---|---|
| Parameters | 0 | 5 | 10 | 15 | SEM |
| Malondialdehyde (MM/L) | 2.21[a] | 1.04[b] | 1.22ab | 1.78ab | 0.18 |
| Superoxide Dismutase (U/L) | 0.58 | 0.37 | 0.53 | 0.54 | 0.05 |
| Glutathione Peroxidase (U/L) | 24.83 | 25.13 | 20.10 | 20.92 | 0.93 |
| Glutathione (U/L) | 16.40[a] | 13.45ab | 12.33[b] | 12.08[b] | 0.69 |
| Catalase (U/L) | 0.10[b] | 0.16ab | 0.27[a] | 0.24ab | 0.02 |

[ab] *Means along the row with different superscripts are significantly ($p<0.05$) different.*
DWMR - Dried Watermelon Rinds
SEM – Standard error of mean

The effect of the experimental diets on the sensory evaluation of meat from rabbits is shown in Table 6. The results revealed that all the parameters were not significantly affected ($p>0.05$), except tenderness. Significant difference ($p<0.05$) was recorded for the tenderness of meat from rabbits fed experimental diets. Meat samples of rabbits fed 15% dried watermelon rinds inclusion level in their diets was the most tender (6.63) compared to the meat samples of rabbits fed 0% and 5% dried watermelon rinds inclusion level in their diets having (6.37 and 6.35) mean values, respectively. Samples of meat from rabbits fed 10% inclusion level in their diets had the least mean score of 5.98. However, the sensory scores for colour, flavour, saltiness overall flavor and overall acceptability tended to be higher for meats from rabbits fed diets containing 15% dried watermelon rinds than the meat from rabbits fed the other inclusion levels. Also, the highest score for juiciness was noticed from the meat of rabbits fed diets containing 5% dried watermelon rinds.

**Table 6: Sensorial meat profile of rabbits fed diets containing dried watermelon rinds**

| | Inclusion level of DWMR (%) | | | | |
|---|---|---|---|---|---|
| Parameters | 0 | 5 | 10 | 15 | SEM |
| Colour | 6.58 | 6.67 | 6.33 | 6.77 | 0.098 |
| Juiciness | 6.02 | 6.07 | 5.75 | 6.00 | 0.113 |
| Flavour | 6.06 | 6.15 | 6.10 | 6.20 | 0.116 |
| Tenderness | 6.37[ab] | 6.35[ab] | 5.98[b] | 6.63[a] | 0.103 |
| Saltiness | 4.87 | 4.65 | 4.45 | 4.80 | 0.088 |
| Overall flavor | 6.25 | 6.55 | 6.27 | 6.68 | 0.113 |
| Overall acceptability | 6.33 | 6.42 | 6.18 | 6.58 | 0.126 |

[ab] *Means along the row with different superscripts are significantly ($p<0.05$) different.*
DWMR - Dried Watermelon Rinds
SEM – Standard error of mean

**Discussion**

Al-Owaimer *et al.* (2014) explained cooking loss as the percentage of water lost during the cooking process. A low cooking loss thereby indicates that the meat has a high water-holding capacity during processing. The inclusion of dried watermelon rinds in the diets of the experimental animals also showed no significant losses in the cooking refrigeration losses of the meat, thereby implying that the experimental diet has no negative effect on the refrigeration loss. These findings contradicted the research conducted by Adegoke *et al*. (2023) who reported that the cooking loss and refrigeration loss of meat from chickens fed dietary white and cayenne pepper powders were significantly affected. There were also no significant differences on the water absorptive power of meat from rabbits fed the experimental diets. Generally, water absorptive power of meat refers to the ability of the meat to take up and retain water (that is, the ability of a meat to take in water). This result is in line with the reports of Okanlawon *et al.,* (2024) who stated that the inclusion of phytobiotics blend (turmeric, garlic, ginger and clove) in the diets of rabbits had no significant influence on the final cook loss, water absorptive power and chilling loss and Kyakma *et al.* (2022) who documented a non-significance difference in water absorptive power of meat of broiler chickens fed diets containing different additives. Since there is an increase in the awareness of rabbit meat and its nutritional value, there is need to improve the meat quality by providing natural antioxidants products as the conventional ones may pose a public health hazard (Suberu *et al.,* 2024). Research carried out by Neglo *et al.* (2021) established that watermelon rind has a very high antioxidant activity like lycopene that can improve their meat quality. Hence, the parameters discussed were compared with researches (Adegoke *et al.,* 2023, Okanlawon *et al.,* 2024, Kyakma *et al.,* 2022.) that had high level of antioxidants in their test ingredients as a dietary inclusion to evaluate the meat of rabbit and poultry because they are both white meats.

The colour of a meat influences how well-liked a meat product is by the consumers (Lee *et al.,* 2008). The inclusion of dried watermelon rinds in the diets of rabbits showed no significant effect on the colour intensities (L*, a* and b*) of the meat. The intensities of colour found in this experiment is similar to that of Mijangos-Santos *et al.* (2022) who reported that intensities L*, a* but b* of meat (Longissimus dorsi muscle) of rabbits were not affected by the different diets and a biological activator.

The decline in fat content observed in meats from rabbits fed diets containing 15% dried watermelon rind (DWMR) could be as a result of the bioactive compounds in DWMR at this inclusion level (15%) which may have influenced the observed lowering of the fatty content present in the meat of the rabbits; likewise, the increase observed in fibre content in meats from 15% DWMR dietary group rabbits might be attributed to the fibre content of DWMR at this inclusion level. The crude fibre range of 0.58-1.11 % recorded in this study is within the negligible range of 1-2% stated for rabbits (Nistor *et al*., 2013). Crude fibre is important in proper and efficient functioning of the digestive system. This result aligns with Gidenne (2015), who reported that dietary fibre from fruit by-products can influence lipid metabolism in rabbits. This trend is supported by research showing that high dietary fibre from fruit rinds can enhance gut health and nutrient absorption efficiency in rabbits (Carabaño *et al*., 2010). The protein and carbohydrate contents showed fluctuations without significant differences, reflecting that DWMR inclusion up to 15% did not drastically alter the essential nutrient balance in rabbit meat, maintaining its nutritional quality (Trocino *et al*., 2013).

This study also shows an increase in high-density lipoprotein (HDL) levels from 47.57 mg/dL in the control to 56.52 mg/dL at 15% DWMR inclusion. Higher HDL is beneficial as it is associated with a reduced risk of cardiovascular diseases, which aligns with research highlighting the positive impact of dietary fibre from fruits on HDL levels (Siri-Tarino *et al*., 2010). Conversely, low-density lipoprotein (LDL) levels also increased, particularly at 15% DWMR (38.13 mg/dL), suggesting a potential rise in atherogenic risk factors, a concern supported by lipid metabolism studies in rabbits fed high-fibre diets (Jenkins *et al*., 2001).

The inclusion of dried watermelon rinds (DWMR) in the diet of rabbits significantly influenced the Malondialdehyde (MDA) levels and antioxidant status of their meat. MDA, a marker of lipid peroxidation, was notably lower at 5% DWMR (1.04 MM/L) compared to the control (2.21 MM/L), indicating reduced oxidative stress with moderate DWMR inclusion. This reduction aligns with findings that natural antioxidants in fruit by-products can mitigate lipid peroxidation (Tomaino and Cione, 2016). The decline observed in Glutathione peroxidase (GPX) and glutathione (GSH) levels suggests a potential depletion of glutathione reserves with increased dietary fibre (Huang *et al*., 2010). Catalase activity at 10% DWMR (0.27 U/L), indicates enhanced hydrogen peroxide breakdown at this inclusion level, which supports the role of dietary antioxidants in boosting catalase activity (Yu *et al*., 2002).

The non-significant effect of dried watermelon rinds on the sensorial meat qualities (tenderness exclusive) of the experimental animals showed that the inclusion of the experimental diets had no adverse effect on the consumers qualities. Meat samples from rabbits fed diets containing 15% dried watermelon rinds was the most accepted by the panelist in terms of overall acceptability, overall flavour, saltiness, tenderness, meat flavor and colour. This study is in agreement with Osei *et al.*

(2022) who carried out research on the sensory characteristics of meat from rabbits fed concentrates diets containing *Brassica oleracea* outer leaves and *Musa paradisiaca* and also reported no significant difference between sensory attributes. However, this study contradicts the findings of Teye *et al*. (2020) who reported a significant difference between the sensory attributes of meat from rabbits in Ghana fed diets containing graded levels of palm (*Elaeis guineensis*) kernel oil residue; they further explained that the tenderness and juiciness of meat from animals on the PKOR-based diets were rated higher ($p < 0.05$) which could be attributed to the higher fat contents of the meat of rabbits on the PKOR-based diets, as several studies reported increased juiciness and tenderness in meat which have higher fat contents. The increased tenderness score observed with increasing level of dried watermelon rind can be attributed to the fact that rabbits can efficiently convert fibre into fat within the muscle resulting into a higher marbling thereby increasing the tenderness of the meat.

## Conclusion and Recommendations

Based on the results of this study, dietary inclusion of dried watermelon rind significantly ($p<0.05$) influenced meat fat and fibre content, reduced lipid peroxidation and enhanced catalase activity. Hence, it can be effectively used as an unconventional feed ingredient without significant loss in the meat qualities

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## References

Adegoke, A.V., Sanwo, K.A., Egbeyale, L.T., Akinola, O.S. and Oyewole, O.M. 2023. Physico-chemical, technological and sensorial qualities of meat and sausage from broiler chickens fed dietary white and cayenne pepper powders. *Carpathian Journal of Food science and technology*, 15(2): 78-93.

Ahn, D. U., Sell, C., Jo, C., Chen, X., Wu, C. and Lee, J. I. 1998. Effects of dietary vitamin E supplementation on lipid oxidation and volatiles content of irradiated cooked turkey meat patties with different packaging. *Poultry Science:* 77:912–920.

Al-Owaimer, A. N., Alyemni, A. H., Suliman, G. M. and Abudabos, A. M. 2014. Effect of different probiotics on breast quality characteristics of broiler under *Salmonella enterica subsp. typhimurium* challenge. *Italian Journal Animal Science* 13(3):450-454.

Al-Sayed, H. M. and Ahmed, A.R. 2013. Utilization of watermelon rinds and sharlyn melon peels as a natural source of dietary fibre and antioxidants in cake. *Annals of Agricultural Science*, 58, 83–95.

AOAC 2005. Official methods of analysis. 17th ed. Washington, DC: Association of Official Analytical Chemists.

Ajagbe A.D., Adubazi, G.I. and Oyewole, B.O. 2022. Nutrient digestibility and Nitrogen utilization of weaner rabbits fed graded levels of watermelon rinds. *Kuwait Research Journal of Agriculture and Life Science*, 1(1): 30-33

Ajala, M.K. and Balogun, J.K. 2004. Economics of Rabbit production in Zaria, Kaduna State. *Tropical Journal of Animal Science*. 7(1): 1-10.

Carabaño, R., Villamide, M., García, J., Nicodemus, N., Llorente, A., Chamorro, S. and de Blas, C. 2010.

New trends in rabbit feeding: influence of nutrition on intestinal health. *Spanish Journal of Agricultural Research*, 8(1), 15-25.

Ewa U. E., Kalu N. C., Adedokun O O., Oka U., Onabanjo R. S and Ezike J.C. 2019. Replacement of maize with graded dry cassava sievate in broiler chicken ration. *Nigeria Journal of Animal Science*. 21(2): 291-300.

Folch, J., Lees, M. and Sloane-Stanley, G. H. 1957. A simple method for the isolation and purification of total lipids from animal tissues. *Journal of Biology Chemistry* 233: 311- 320.

Gidenne, T., 2015. Dietary fibres in the nutrition of the growing rabbit and recommendations to preserve digestive health: a review, *Animal*, 9, 227-242.

Guzek, D., Glabska, D. and Gutkowska, K. 2013. Meat quality and consumer preferences. In *Food Sciences: Developments in Technologies, Treatments and Processes* (pp. 1-20) Nova Science Publishers.

Huang, D., Ou, B. and Prior, R. L. 2010. "The chemistry behind antioxidant capacity assays." *Journal of Agricultural and Food Chemistry*, 53(6), 1841-1856.

Hunt, P., Gulisano, M., Cook, M., Sham, M. H., Faiella, A., Wilkinson, D., Boncinelli, E. and Krumlauf, R. A. 1991. Distinct Hox code for the branchial region of the vertebrate head. Nature. *International Journal of Poultry science*. 3 (12): 779-782.

Jang, H. D., Chang, K. S., Huang, Y. S., Hsu, C. L., Lee, S. H. and Su, M. S. 2007. Principal phenolic phytochemicals and antioxidant activities of three Chinese medicinal plants. *Food Chemistry*. 103:749–756

Jenkins, D. J., Kendall, C. W., Axelsen, M., Augustin, L. S., and Vuksan, V. 2001. "Viscous and non-viscous fibres, nonabsorbable and low glycemic index carbohydrates, blood lipids and coronary heart disease". *Current Opinion in Lipidology*, 11(1), 49-56.

Kyakma, S. S., Tella, T. K. and Sanwo, K. A. 2022. Some meat quality parameters of broiler chickens fed diets containing different additives. *Nigerian Journal of Animal Production* 49(2): 33-45.

Lee, Y. S., Saha, A., Xiong, R., Owens, C. M. and Meullenet, J. F. 2008. Changes in broiler breast fillet tenderness, water-holding capacity and colour attributes during long-term frozen storage. *Journal of Food science*.73: E162-E168.

Lius, P. 2003. *Exploring Important Medicinal Uses for Watermelon Rinds*. United States Department of Agriculture, Agricultural Research Service. https://www.ars.usda.gov

Mijangos-Santos, N. A., Villegas-Aparicio, Y., Gómez-Vázquez, A., Hernández-Bautista, J., Govea-Luciano, A., Montañez-Valdez, O. D., and Rubio-Arias, H. O. 2022. Meat production and quality of rabbits fed different diets and a biological activator. *AgroProductivdad*. https://doi.org/10.32854/agrop.v15i7.2341

Neglo, D., Tettey C. O., Essuman, E. K., Kortei, N. K., Boakye, A. A., Hunkpe, G., Kwaishe, P., Devi, W. S. 2021. Comparative antioxidant and antimicrobial activities of the peels, rind, pulp and seeds of watermelon (*Citrullus lanatus*) fruit. *Scientific African*, 11, e00582, ISSN 2468-2276. https://doi.org/10.1016/j.sciaf.2020.e00582

Nistor, E., Bampidis, V., Pacala, N., Pentea, M., Tozer, J. and Prundeanu, H. 2013. Nutrient content of rabbit meat as compared to chicken, beef and pork meat. *Journal of Animal Production Advances* 3(4), 172-176.

Okai, D. B., Boateng, M., Amaoh, K. O. and Johnson, L. D. 2010. Studies on dried water melon rinds on the nutrient composition and effects on growth performance and carcass characteristics of Albino rats. Proceedings of the 30th Ghana Animal Science Association Conference. Pp. 98 – 103.

Okanlawon, E. O., Bello, K. O., Akinola O. S., Adeola A. A. and Ademolue R.O. 2024. Influence of phytobiotics blend (turmeric, garlic, ginger and clove) on cook loss, water absorptive power, chilling loss and colour of rabbit meat. Proceedings at the 49th Annual Conference, Nigerian Society for Animal Production: 24th – 27th March, 2024, University of Ibadan, Nigeria

Osei, D. O., Apori, S. O., Hagan, J. K., Asuming-Bediako, N., Amedorme, D. and Asiedu, P. 2022. Sensory characteristics of meat from rabbits fed concentrate diets containing *Brassica oleracea* outer leaves and *Musa paradisiaca* leaves. *Ghana Journal of Science, Technology and Development*, Vol. 8 (2): 104 – 113.

Osman, M.A., and Moustafa, E.M. 2019. The effect of feeding dried watermelon (*Citrullus lanatus)* rinds on growth performance and carcass traits of growing rabbits. *Journal of Animal and poultry production*. 10(7): 339-344

Otu, B. O., Banjo, A. A., Kolo, S. P., Balogun, A. M. and Dabban, A. I. 2021. Growth performance and nutrient digestibility of broiler chickens fed diets containing varying inclusion levels of dried watermelon rind at the starter phase. *Nigerian Journal of Animal Production*, 48(3): 134-141

Sanwo, K.A., Iposu, S.O., Osho, A.O. and Abiola, S.S. 2011. Growth performance, Nutrient intake and digestibility of goat fed melon husk and palm oil slurry at 30% inclusion level. *Nigerian Journal of Animal production*. 38(2): 148-154.

Siri-Tarino, P. W., Sun, Q., Hu, F. B. and Krauss, R. M. 2010. "Meta-analysis of prospective cohort studies evaluating the association of saturated fat with cardiovascular disease." *American Journal of Clinical Nutrition*, 91(3), 535-546.

Statistical Package for Social sciences (2012). IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.

Suberu, S. A., Isikhuemhen, O. S., Ogundare, T. E., Ekunseitan, D.A. and Fasina, Y.O. 2024. Benefits of Mushroom-based supplements on growth performance, immunocompetence and meat quality in poultry. *Animals,* 14(11): 15-17

Sun, Y., Oberley, L. W. and Li, Y. 1988. A Simple Method for Clinical Assay of Superoxide Dismutase. *Clinical Chemistry*, 34, 497-500.

Teye, M., Barku, V. and Hagan, J. 2020. Fatty Acid Profile, Carcass and Meat Quality Attributes of Rabbit Breeds in Ghana Fed Diets with Graded Levels of Palm (*Elaeis guineensis*) Kernel Oil Residue. *Advances in Animal and Veterinary Sciences,* 8(10):1091-1099.

Tomaino, A. and Cione, E. 2016. Antioxidant activity of fruit by-products and their potential for preventing oxidative stress in humans. *Journal of Functional Foods*, *21*, 406-415.

Trocino, A., García, J., Carabaño, R. and Xiccato, G. 2013. "A meta-analysis on the role of dietary fibre in growing rabbits: effects on growth performance, health and digestion." *Animal Feed Science and Technology*, 173(1-2), 87-101.

Yam, K.L. and Papadakis, S.E. 2004. A Simple Digital Imaging Method for Measuring and Analyzing Colour of

Food Surfaces. *Journal of Food Engineering*, 61: 137-142.

Yu, B. P., Yang, R. and Choi, J. 2002. "Aging and oxidative stress: Modulation by dietary restriction." *Free Radical Biology and Medicine,* 32(6), 424-428.

Zhao, W., Pin, L. V. and Gu, H. 2013. Studies on carotenoids in watermelon flesh. *Agricultural Sciences*. 4: 13-20. DOI: http://www.dx.doi.org/ 10.4236/as. 2013.47A003