Global Journal of Agricultural Research, 12(2), 29-39, 2024
Print ISSN: 2053-5805(Print),
Online ISSN: 2053-5813(Online)
Website: https://www.eajournals.org/
Publication of the European Centre for Research Training and Development -UK

Feeding Regimes and Processing Effect on Rabbit Meat Quality: Exploring the Sensory Categorical Profiles

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doi: https://doi.org/10.37745/gjar.2013/vol12n22939 Published July 14, 2024

Citation: Farinde, A. J., Dauda, T. O., Farinde E. O., Alabi, D. L. and Oladepo, W. O. (2024) Feeding Regimes and Processing Effect on Rabbit Meat Quality: Exploring the Sensory Categorical Profiles, *Global Journal of Agricultural Research*, 12, (2), 29-39

Abstract: *Quality of rabbit meat product for consumers' acceptability could be affected by the feed and processing method. This study aimed at evaluating the organoleptic quality of rabbit meat as affected by feed types and processing. Cooked and roasted meat from rabbits fed on three feeding regimes were sensory evaluated. Kruskal-Walis's test showed that there exist significant difference in the rankings by the assessors for colour and aroma ($H_{(19:0.05)}$ = 34.76 and $H_{(19:0.05)}$ = 42.4) respectivly. Average median ranking of rabbit meat tenderness ranged between 27.7 for assessor A_8 and 87.7 for assessor A_5. Average ranking of the taste of the rabbit meat falls from 104.5 for assessor A_{12} to 24.5 for assessor A_{15}. The overall acceptance of the rabbit meat by the assessor indicated that all the assessors (100%) accepted the rabbit meat. Roasting as processing method and use of combination of forage and concentrates as feeds impart good quality on the processed rabbit meat.*

Key words: rabbit, sensory evaluation, ranking, cooking, roasting, feeding regime

INTRODUCTION

Rabbit meats are very suitable to application of modern processing techniques which can accommodate a wide variety of product size and shapes leaving bone intact, being ideal for whole carcass, halves and large and small cut-up parts (Petracci, 2012). Such products can be used for oven-cooked, smoked and roasted rabbit products. Petracci et al. (2012) reported that rabbit meat's ability to retain water during processing and tenderness can be improved by

marination. Pre-treatment with vinegar, wine or lemon juice, salt and spices of rabbit meat before cooking could also help to improve its juiciness and tenderness. Today, majority of rabbit meat is sold in form of whole carcass and cut-up for consumption, strictly remaining a commodity in which almost all consumption was based on home preparation due to the small size of the animal of which a single rabbit would offer nothing more than product than could be consumed at one sitting. Addition of rabbit meat in traditional meat products and its inclusion in development of functional food products due to its health benefits could help to increase its consumption and enhance its market values. Rabbit meats could be made into sausages and pies and smoked or roasted as meat snacks and well packaged in vacuum pack or polystyrene tray overwrap with polyvinyl plastic film.

White meat including poultry and rabbit are now been accepted as healthy food with high protein, low fat, low cholesterol and with high heme-iron content as opposed to the red meat which include beef, pork and mutton that are high in the healthy risk elements and the white poultry meet are attracting high market demand nowadays (Fletcher, 2002).
Sensory analyses usually vary depending on the sensory variables hence the need for specificity analysis (using Kruskal – Walis's test) of the categorical data as adopted in the current study. Consumers and producers alike can make well-informed decisions that eventually support the rabbit meat industry's development by performing sensory evaluations.
The objective of the research is to determine the effects of feeds and two processing methods on the organoleptic quality of rabbit. By categorizing the different attributes of the meat and comparing them between the two methods, differences in quality can be identified and potentially improve the processing techniques to enhance overall consumer satisfaction.

MATERIALS AND METHODS

Source of Rabbits

Three sets of weaned Hyela Rabbit at the age of five (5) months were obtained from Onileola Rabbit Farm in Ede, Osun State, Nigeria Initial weight of the rabbits at point of collection was recorded.

Housing, Feeding and slaughtering of the rabbits

The rabbits were housed in semi closed wire cages in three tiers batteries pen made from Aluminum nets and poles in the rabbitry. The environmental conditions were adequately monitored and all the cages were equipped with feeding hoppers and drinking nipples. Each tier of cages were built over Faeca and Urine separate collectors to maintain high level hygiene and safe collection of rabbit wastes for laboratory analyses. The rabbits were fed on three types of feeding regime. One set of rabbits was fed on forages like Moringa Leaves (*Moringa oleifera,* Centro/Butterfly peas (*Centrosema pubescens*); Aspilia (*Aspilia africana*); Potato Vines and Leaves (*Ipomea batatas)*; Sunflower (*Helianthus annuus)*; and Milk Weed (*Euphorbia heterophyla*) the second set was fed on concentrates called Rabbit Pellet. The concentrate

contains Wheat bran, Groundnut meal, Palm kernel meal, Soyabean meal, Cassava peel, Maize, Rice hulls, Sodium Bicarbonate, Salt (Sodium Chloride), Limestone, L-lysine HCl, Toxin Binder, DL-methionine, and Vitamin Premix). While the third set was fed on combination of forage and concentrates respectively. The rabbits were fed for 90 days after which one rabbit from each set was slaughtered according to the standard guidelines for euthanizing rabbits after 24h fasting. The slaughtered rabbits were skinned and appropriate part was processed for sensory evaluation

Processing for sensory evaluation

Meat flesh of thigh of each of the rabbits was subjected to cooking and roasting. The meat was placed in 0.5% aqueous solution of sodium chloride for 15 minutes prior to cooking and roasting. Cooking was carried out on a gas burner while roasting was done in roasting kiln. The processed meat samples were coded and placed in stainless dish for sensory evaluation.

Sensory evaluation of the rabbit's meat samples

The coded samples consisting of the treatment combinations were- forage fed cooked rabbit refer hereafter as FFCR, foraged fed roasted rabbit refer hereafter as FFRR, concentrates fed cooked rabbit refer hereafter as CFCR, concentrate fed roasted rabbit refer hereafter as CFRR, concentrate and forage fed cooked rabbit refer hereafter as CFFCR as well as concentrate and forage fed roasted rabbit refer hereafter as CFFRR. Coded cooked and roasted rabbit meat samples were presented to twenty (20) semi trained panel of judges who are both members of staff and post graduate students of Faculty of Agriculture, Obafemi Awolowo University, Ile-Ife and are familiar with rabbit meat. The panelists were asked to score the samples for colour, flavor, tenderness, juiciness, taste and overall acceptability using 5 point hedonic scale where 1 represent Dislike very much and 5 represent Like very much. The panelists were provided with water for mouth rinsing after each tasting.

Data obtained were subjected to visual analysis of the Kruskal-Walis's test results for both assessors and samples. The goal of Kruskal-Wallis's test was to establish stochastic difference between three or more levels of factors (Yinglin, 2020). In other words, there should be no relationship between the members in each group or between groups.

RESULTS AND DISCUSSION

Response Variability Studies of the OrganolepticAssessment of Rabbit Meat

The median ranking of the rabbit meat colour falls between 3 and 5 while 4 is the most frequent median rank by the assesors (Figure 1). Both the first and the tenth assesors returned the same highest aggregate ranking of 85.2 while the 15th assessor has the least aggregate ranking of 17.5. There exist significant difference in the rankings by the assessors because $H_{(19:0.05)} = 34.76$ is significant ($P < 0.05$ – Figure 1) despite the fact that some assesors returned the same ranking. The implication of this result is that rabbit meat appeal differently to each of the assessors.

Similarly, the assessors can be paritioned into six stochastically significant classes according to the meat aroma. The Kruskal-Wallis statistics obtained, $H_{(19:0.05)} = 42.4$ was significant ($P < 0.05$ – Figure 2).

Median rating for the juiciness of the rabbit meat ranged from 2.5 by the 15th assessor to 5 for the 5th , 10th,14th and 17th assessors. All other assessors were formed into other four groups of 4.5, 4.3 and 3.5 (Figure 3). This result, $H_{(19:0.05)} = 45.19$ is significant ($P < 0.05$ – Figure 3). Rabbit meat tenderness can stochastically be grouped into 3 significantly different classes according to assessors' rating. The highest rating "5" was returned by both assessor A_5 and A_{12} while the least rating "3" was obtained with assessors A_3, A_6,A_8 and A_{11}. Other assessors fall in the rating category of "4" and this result, $H_{(19:0.05)} = 33.26$ is significant ($P < 0.05$ – Figure 4). The average median ranking of rabbit meat tenderness ranged between 27.7 for assessor A_8 and 87.7 for assessor A_5 (Figure 4). Rabbit meat's taste have median ranks ranging between "2.5" for Assessor A_{15} and "5" for both assessor A_2 and A_{17}. All other 3 median rating (4.5, 4.0 and 3.5) fall between these 2 extreme classes (Figure 5). The statistics, $H_{(19:0.05)} = 49.2$ obtained for the median ranking is statistically significant ($P < 0.05$). Average ranking of the taste of the rabbit meat falls from 104.5 for assessor A_{12} to 24.5 for assessor A_{15} (Figure 5).

The overall acceptance of the rabbit meat by the assessor indicated that all the assessors (100%) accepted the rabbit meat though their median rating differs significantly (Figure 6). The median ranking ranged between "3" for assessor A_8 and "5" for assessor A_5 and A_{17}. The Kruskal-Wallis's statistics ($H_{(19:0.05)} = 41.73$) is significant. The implication of these results is that there exist disparity in the judgement of the assessors though a concesus product can be obtained. The disparity in the ranking of the rabbit meat by the assessors may indicate independency of the assessors' rating since each assessor is expected to develop a self-attributing scale of ranking as posited by Drake *et al* (2023). This disparity/independency in ranking by the assessors also fulfills one of the assumptions of the use of Kruskal-Walis statistics for sensory analysis. Assumption of independence of ranking, composition of two or more categorical variables, dependent variable(s) measured in ordinal or continuous variable and similarities in the distributions of the response are germane to Kruskal-walis test (Yinglin, 2020).

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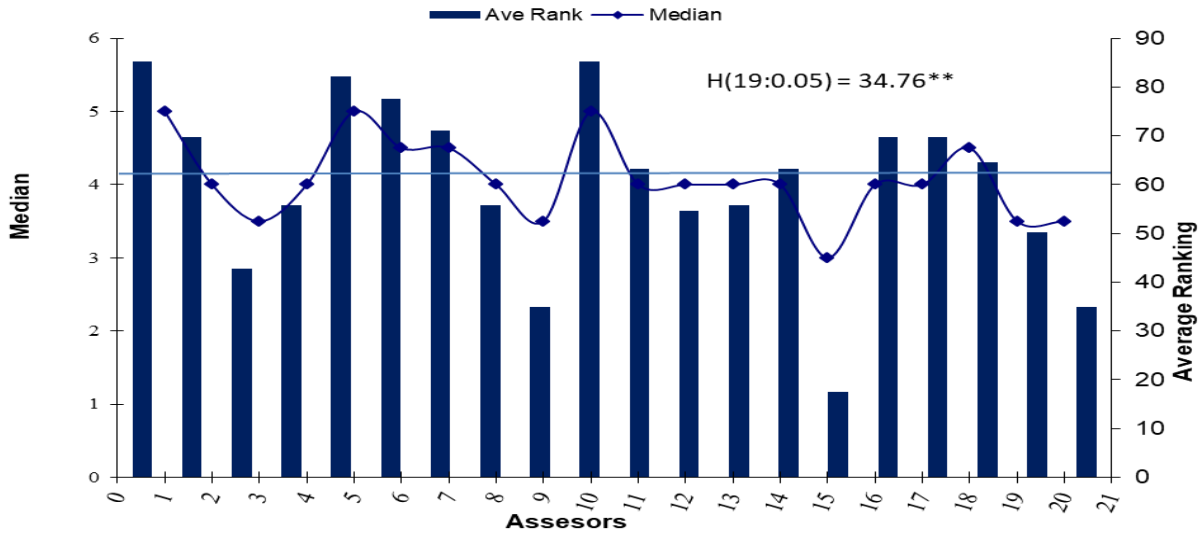

Figure 1. Visual Analysis of the Kruskal-Wallis Analysis Result of the Colour of the Meat by Different Assesors.

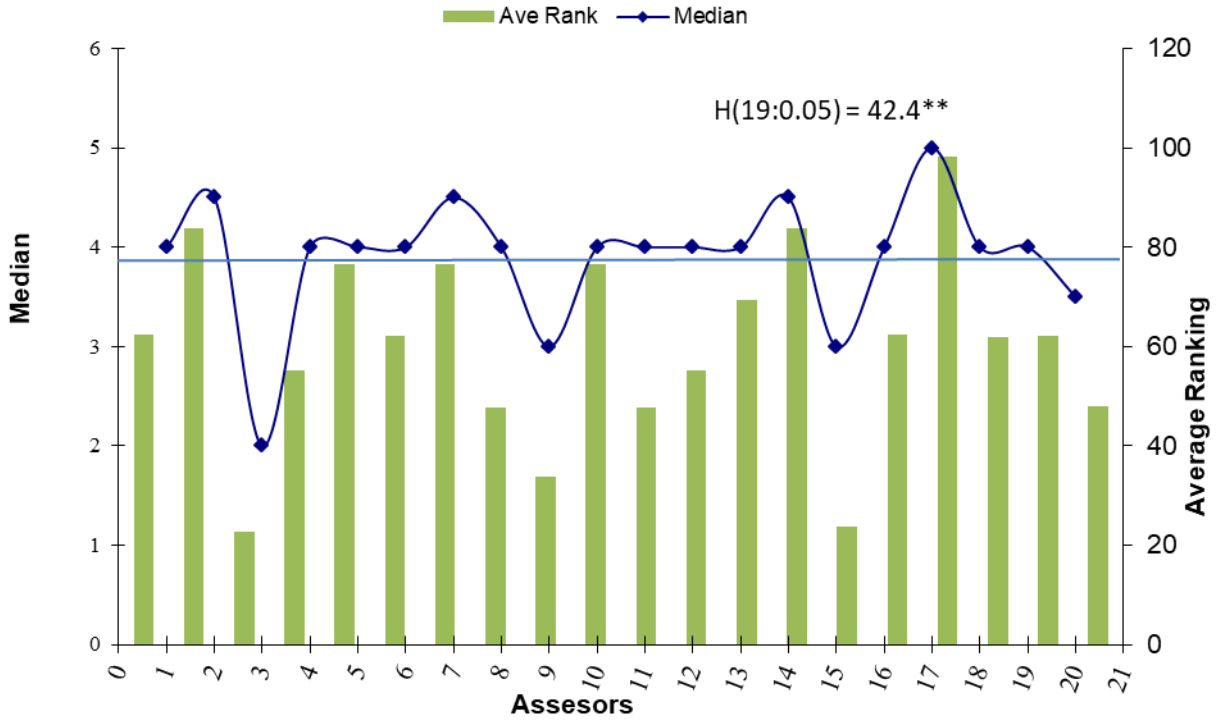

Figure 2. Visual Analysis of the Kruskal-Wallis Analysis Result of the Aroma of the Meat by Different Assesors.

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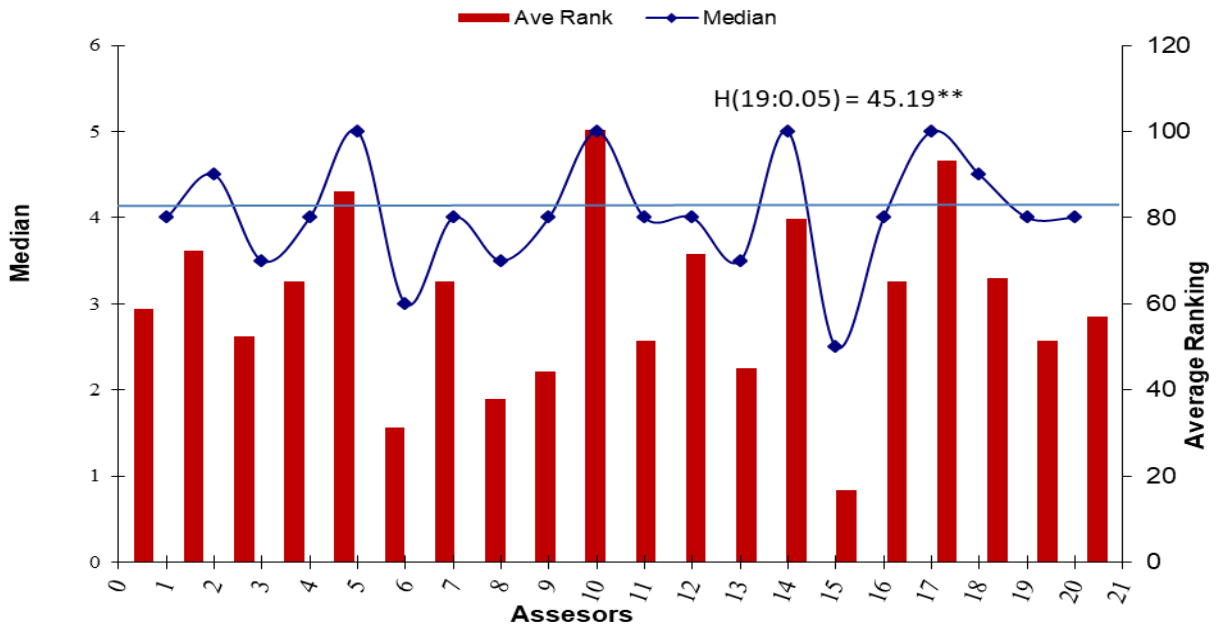

Figure 3. Visual Analysis of the Kruskal-Wallis Analysis Result of the Juiciness of the Meat by Different Assesors.

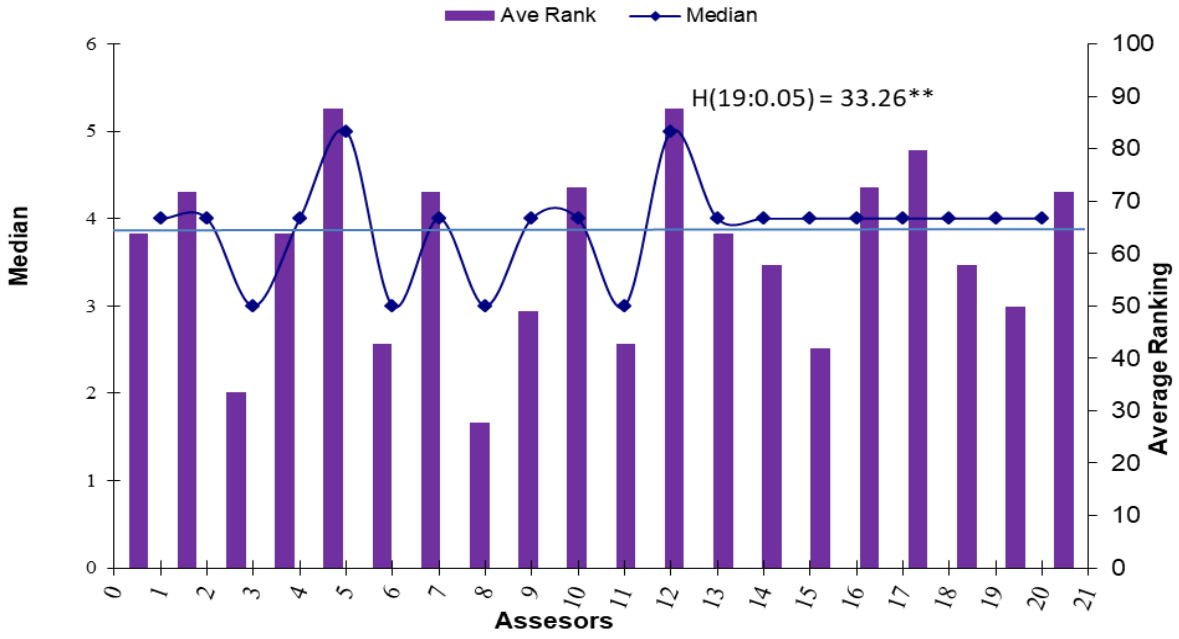

Figure 4. Visual Analysis of the Kruskal-Wallis Analysis Result of the Tenderness of the Meat by Different Assesors.

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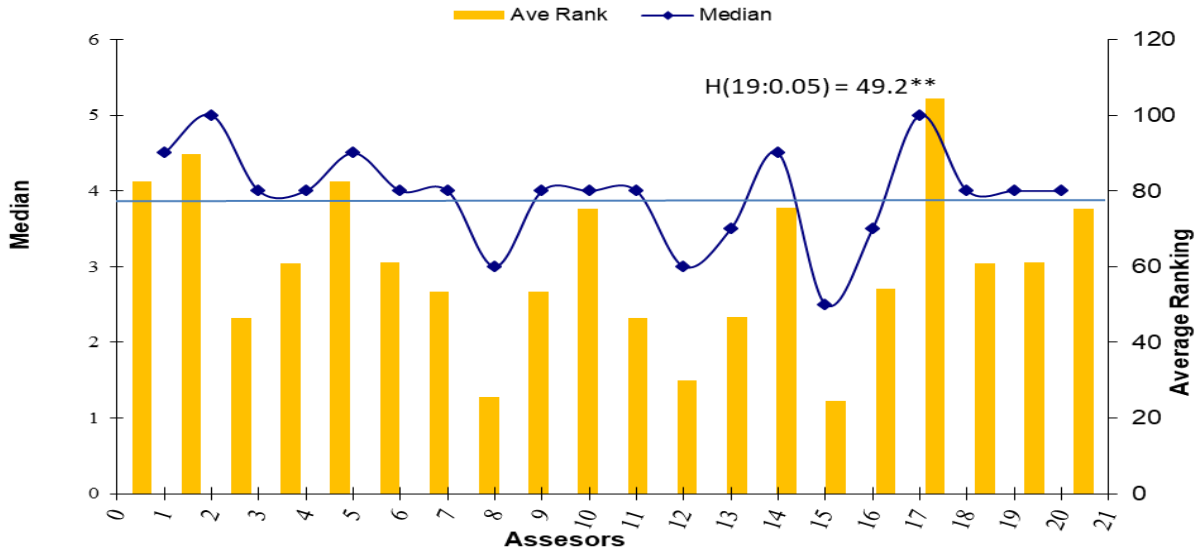

Figure 5. Visual Analysis of the Kruskal-Wallis Analysis Result of the Taste of the Meat by Different Assesors.

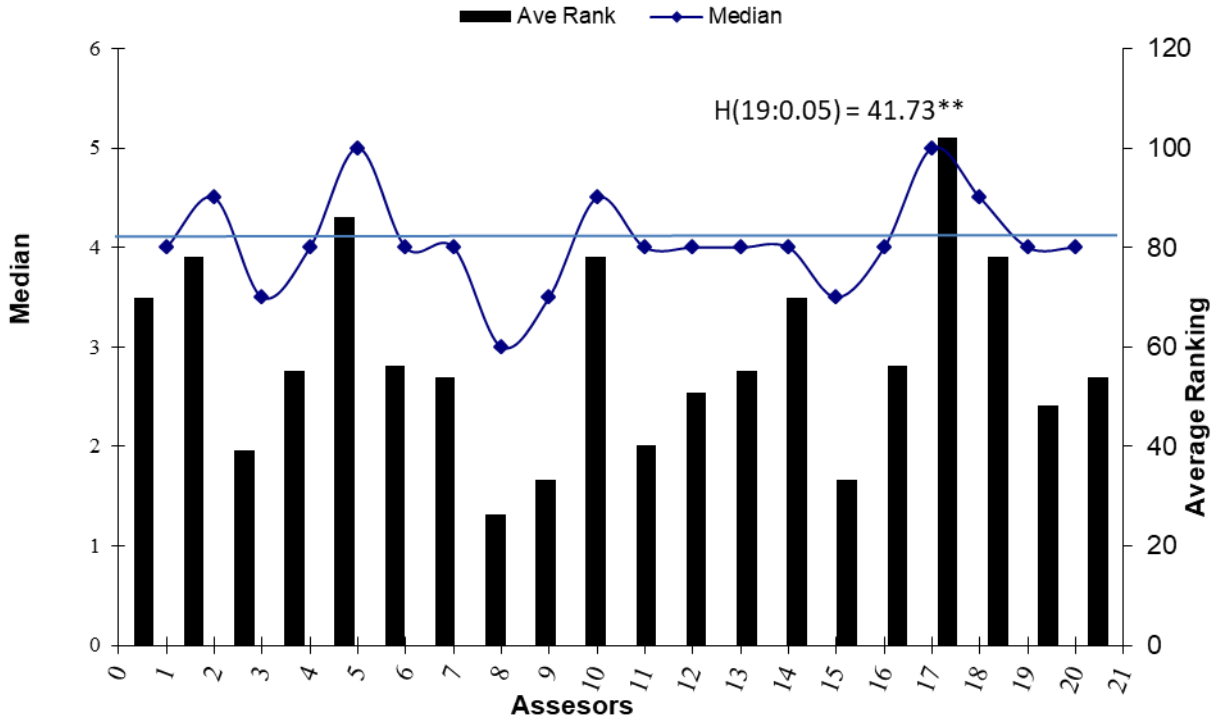

Figure 6. Visual Analysis of the Kruskal-Wallis Analysis Result of the Overall acceptability of the Meat by Different Assesors.

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Statistics results of Oganoleptic Analysis of Rabbit meat as Affected by Processing and Feeding Types

The Kruskal-Wallis test of the colour of the rabbit meat indicated that the RRFFC is significantly the most attractive sample and was ranked "5" and it is significantly higher than the remaining samples which were equi-ranked "4". This statistics, $H_{5:0.05}$= 24.23 is significant (P < 0.05 – Table 1). The average ranks fall between 38.6 for CRFF and 78.6 for RRFFC. The least averagely ranked rabbit meat in terms of colour was CRFF with median ranking of 38.6. It is obvious from this results that roasting retained the colour of meat than cooking and that combination of forage and concentrates as feed impart positively on the colour of the rabbit meat product since the meat with highest colour ranking was the rabbit fed with both forage and concentrates. The nutritional differences between forage and concentrate diets for rabbits have been established to affect the sensory quality of the rabbit meat. This can be hinged on the diet composition which consequently affects the slaughter weight. It has been found that feeding rabbits with diets that has varying fibre content and energy levels can impact on the luminosity and colour intensity of the meat (Carrilho *et al*, 2009). Similarly, the diet of the rabbits was found to influence the flavor and aroma of the meat (Petracci *et al*, 2009 and Khan *et al*, 2016). The best impact of forage on the meat quality noticeably remained the most desirable in the face of skyrocketing price of compounded feeds. This agrees with Nutautait, *et a*l (2023) who established that diets enriched with freshwater *Cladophora glomerata* (*Macroalgal* biomass) can enhance the taste of rabbit meat by affecting sensory attributes such as flavor, odor, texture, and visual appearance. The effects of feeds on rabbit meat quality was indeed in the inclusion and substitution of some feed components and not in the total replacement of the feeds as established by Kumar *et al.* (2023).

The median ranking of aroma of rabbit meat can be partitioned into 2 non-significantly different classes. The median ranking "3" obtained for RRFF is significanly less than "4" obtained for the remaining samples. The average median ranking ranged from 49.5 for RRFF to 65.7 for RRFC. The Kruskal-Walis statistics, $H_{5:0.05}$= 5.00 obtained for the aroma is not significant (P > 0.05 – Table 1). The implication is that roasted rabbit fed with concentrates has the best gustatory delight. This can be hinged on the reduced forage that could have influenced the taste and aroma status of the rabbit meat. Originally, rabbit meat has been found to have a typical smell and taste of forage or grass (Li *et al*, 2018). Roasting and feeding with concentrates can thus be said to have reduced the forage smelling or taste of the rabbit meat. The median ranking for the juiciness of the rabbit meat can be grouped into 3 significantly different strata. The median rank obtained for RRFC "5" is significantly the highest and higher than the median, "4" obtained for RRFFC, CRFC, CRFF and CRFFC. The least median ranking, "3" was obtained for RRFF and the Kruskal-Walis statistics, $H_{5:0.05}$= 11.86 is significant for this results (P < 0.05 – Table 1). The median ranking for tenderness, taste and overall acceptability were the same and the Kruskal-Walis statistics, $H_{5:0.05}$= 4.31, 5.28 and 8.97 obtained for tenderness, taste and overall acceptability were not significant (P > 0.05 – Table 1). It can be established that roasting enhanced rabbit meat juiciness and it is in accord with Combes *et al* (2008) who establishes a cannonical relationship between juiciness and some other varriables including roasting. Also, RRFC returned the highest median ranking for tenderness, taste and overall acceptability thus roasting and concentrates inclusion effects are identified. This is in contrast with Apata *et al*, (2012) where fried rabbit meat were accepted more than broiled, roasted and stewed ones. From the general sensory analysis of the rabbit samples, it is safe to conclude that roasting is the best and most favoured rabbit meat over the other processing method (cooking) and this agrees with Abdel-Naeem *et al* (2021). Oven-roasting was found to be the best processing methods in Abdel-Naeem *et al* (2021) report.

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Table 1. Summary of the Results of the Organoleptic Analysis of the Rabbit Meat as Affected by Processing and Feeding Types

Samples	Colour		Aroma		Juiciness		Tenderness		Taste		Overall acceptability	
	Median	Ave Rank	Median	Ave Rank	Median	Ave Rank	Median	Ave Rank	Median	Ave Rank	Median	Ave Rank
RRFF	4	38.6	3	49.5	3	43.7	4	61.5	4	49.5	4	46.8
CRFF	4	72.9	4	70	4	58	4	50.9	4	63.1	4	63.6
CRFC	4	51.4	4	57.9	4	68	4	64.1	4	63.9	4	57.8
RRFC	4	69.8	4	65.7	5	71.3	4	70.4	4	69.7	4	63.3
CRFFC	4	49.3	4	57.1	4	51.6	4	57	4	53.7	4	50
RRFFC	5	78.6	4	62.7	4	70.3	4	59.1	4	63.1	4	72.3
	H = 24.23**		H = 5.00		H = 11.86*		H = 4.31		H = 5.28		H = 8.97	

CONCLUSION

It is essential for both farmers and consumers to evaluate the quality of rabbit meat using sensory analysis. Consumers judge the overall quality, freshness, and tenderness of rabbit meat using their senses while purchasing it. Likewise, in order to ensure that the product satisfies legal criteria and has a consistent taste and feel, producers also use sensory analysis. In the current investigation, it was found that roasting as processing method and use of combination of forage and concentrates as feeds impart good quality on the processed rabbit meat for its overall acceptability.

ACKNOWLDGEMENT

The Federal Government of Nigeria is appreciated through Tertiary Education Trust Fund (TETFUND) that sponsored the project. Obafemi Awolowo University that housed the project is also acknowledged for providing the raw materials and facilities used for the study.

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