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Characterisation of microbiological and sensory properties of chicken sausage processed with natural preservatives

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ABSTRACT: Poultry meat products especially sausage (hotdogs) is among the fastest growing food commodities on the markets in many parts of the world. In order to fulfil consumer's desire for healthier chicken sausage, local chickens were used to process low-fat sausage using sunflower oil as pork-fat replacer. Chicken breast meat was extracted, ground, mixed with spices (ginger, garlic, chilli pepper, cloves, thyme, black pepper, white pepper, coriander, rosemary, cumin) which were used to replace the harmful chemical additives. Two different samples unpasteurized and pasteurized sausage were successfully processed. Microbiological and sensory analysis were carried out. The heat significantly decreased the microorganism level up to obtain an acceptable product according to the food quality assessment criteria. The mean score percentage showed that 84.66% of the panellists accepted the local chicken sausage. Purchase power Analysis revealed that more than 81% of the panellists declared that they will buy the product. This research work results successfully created a standardized method of sausage formulation using natural spices as preservatives and which can easily be adopted by households.

KEYWORDS: poultry, sausage, pasteurization, physicochemical, microbiology.

1 INTRODUCTION

Poultry meat demand is increasing enormously around the world but in particular in developing countries due to the relative low cost and nutritional relevance [1], [2]. Poultry meat refers to the edible portions of any domesticated avian species, such as chicken, duck, turkey, geese, guinea fowl, and Japanese quail [3]. That edible portions of poultry meat can be cooked to eat or processed in different poultry meat products such as sausage, frankfurter, salami, hamburger and meatballs. The word sausage is from the Latin word "salsus", which means salted meat or preserved by salting [4]. Sausage is defined as a mixture of mostly ground meat, fatty tissue, curing agent, salt, nitrite, sugar and spices filled into casings and further processed by using different processing methods such as cooking, pressure heating, drying, fermentation and canning [5], to improve the nutritional and health qualities of the products. The microbiological stability of fresh or pasteurized sausages may be increased by the addition of curing ingredients such as salt, nitrate and other ingredients that significantly modify the physical, chemical and microbiological properties of the meat products [6]. The food industry extensively uses synthetic chemical preservatives to delay degradation, which is caused by microbial growth, enzymatic activities and oxidative reactions. Preservatives normally stops microbes from multiplying and thereby preventing the spoilage in the processed food product [7]. As their name suggests, synthesis or artificial food additives are synthetic ingredients added to food to enhance its colour or flavour, taste, texture, and extend its shelf life, or improve it in some way [7]. Reference [8] ensures that all food additives on the market are safety for use. Nevertheless, most food industries have abused the used of these artificial food additives for selfish interest. However, due to the synthetic preservatives in meat, potential health damage such as cardiovascular diseases, neurodegenerative

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diseases, cancers among others may occur, consumers are becoming sceptical to buy meat products containing such additives [9]. Therefore, there is the growing consciousness among customers for food with high nutritional value, free from chemical preservatives, and microbiological safety [9]. In spite of modern improvements in slaughter hygiene and food production techniques, food safety is an increasingly important public health issue and most food industries are now intensively interested in finding natural food preservatives. These food preservatives can be extracted from natural sources such as olives, fruits, grapes, vegetables, spices, herbs, algae, and among others. The meat preservatives restrict microbial activity, enzymatic chemical and physical reactions, extend shelf life and improve sensory characteristics of the food product [10]. Species such as thyme, white pepper, black pepper, ginger, garlic, chilli pepper, cumin and oregano have increasingly gained the interest of researchers and food processors as potential natural antimicrobial and antioxidant agents [11]. Therefore, the aim of this study was to produce and characterize the microbiological and sensorial analysis of local processed sausage with local spices.

2 MATERIAL AND METHODS

2.1 MATERIAL

Fresh local matured Birds (30 weeks old) were obtained from CERSA (Centre d'Excellence Régional sur les Sciences Aviaires) at Université of Lomé, Togo. African spices (ginger, garlic, cloves, black pepper, white pepper, chilli pepper, coriander, cumin, rosemary), sunflower oil, cellulose casing, cow intestine, wheat flour, lemon juice and salt were purchased at the local market of Lomé, Togo.

PRODUCTION OF SAUSAGE

In this experiment, the halal (permissible) rules of slaughtering were applied at the slaughterhouse. Ten kilograms of chicken breast meat without bones and skin was ground with the help of a food processor (FUNKOL 800W Electric Meat Grinder) equipped with a 14-cm blade for 5 minutes at the highest speed. 7% of the mixed spice composing of ginger, garlic, chilli pepper, cloves, thyme, black pepper, white pepper, coriander, rosemary and cumin were added in bits to the ground meat while processing. Salt (2%), was added to the minced meat. Then 5% sunflower oil was added and homogenised using a hand-held food mixer for 1 minute to form a coarse emulsion. 2% of wheat flour as a binding agent was added. The minced meat was placed in the deep freeze for 1hour 30 minutes. Then it was removed from the fridge and put in the meat grinder for filling into stuffed artificial cellulose casings. Each stuffed sausage weighed approximately 300g and had a size of approximately 14cm to 18cm. sausage was then cooked at 100°C for 10 minutes. Then the samples were used to explore the microbiological and sensory analysis.

2.2 METHODS

2.2.1 CARCASS YIELD/DRESSING PERCENTAGE

Dressing percentage or carcass yield, as it is sometimes referred to as, is the proportion of ending live weight yielded after animals have been stunned (desensitized), exsanguinated, skinned or scalded, and eviscerated. The term 'dressing percent' is frequently used in slaughtering procedure. The carcass weight is expressed as a percentage of the weight of the live animal just before slaughtered and the weight after slaughtered. Feed withdrawal for the birds was done 12 hours before slaughtering of the animal early in the morning. The weight of each bird was taken and recorded before it was slaughtered. This same procedure was carried at each production time.

Carcass Yield/killing-out percentage = (carcass weight/live weight) *100**.**

2.2.2 MICROBIOLOGICAL ANALYSIS

This aspect of analysis was based on the assessment of the possible microbes present in the processed sausage samples (pasteurized and unpasteurized) before the sensorial analysis. It started with the preparation of disposable Petri dishes, 0.1% sterile peptone water, preparation of media, serial dilution, labelling of Petri dishes, plating/incubation and ended with counting (enumeration) of observed microbes. Two (2) samples were analyzed according to the reference [12]. The different methods used for the enumeration of the sausage microorganism were shown in Table 1.

Table 1. Different food microbes enumerated in the chicken sausage samples

Germ	Reference of the method used	Reactive culture media	Level of dilution	Temperature/duration of incubation
Total aerobic mesophilic germs	NF EN ISO 4833-1	Plate Count Agar	-1, -3, -5	30°C/24 -72hours
Enterobacteria	NF EN ISO 21528-2	VRBL	0, -1	30°C/24hours
E. coli	NF EN ISO 16649-2	Brillance E-Coli	0, -1	44°C/ 24hours
Anaerobic Sulphite Reductors Germs	NF EN ISO 15213	Typotone sulfite Neomycine		37°C/24-48hours
Staphylococcus aureus	NF EN ISO 6888-1	Baird Parker	-1, -2, -3	37°C/24-48hours
Salmonella sp.	NF EN ISO 6579-1	EPT, Rappaport, Hektoen, Galery API 20^E		37°C/24hours
Yeast and Molds	NF EN ISO 21517-152	Sabourand + Chloramphenicol	0, -2	30°C/48-72hours

2.2.3 SENSORY EVALUATION OF THE CHICKEN SAUSAGE

Sensory Evaluation is a scientific method that evokes, measures, analyses, and interprets responses to products, as perceived by the senses of sight, smell, touch, taste, and sound. Sensory quality is very vital to the realization of a consumer's food preference. It consists of qualitative, quantitative, or hedonic quality measurement. Ideal poultry meat is considered to have high nutritive value and great functional roles such as flavour, tenderness, juiciness of the pasteurized product among others [13]. For chicken sausage, the main sensory features are: colour, tenderness, juiciness and flavour [14]. A total of 42 (48% Male and 52% Female) un-trained panellists who were however familiar with sensory evaluation but not with this particular product. The panellist was asked to evaluate the different sensory attributes of the processed sausage sample. Sample were pasteurized and served at room temperature. Sausage samples were sliced to 1-cm thick, put on a white dish, which was individually labelled with 3-digit random numbers, and served to panellists in a random order. Each judge was introduced to a sensory evaluation score sheet. The ranking of the different sensory attributes ranged from 1-7. The following attributes; taste, colour, aroma, texture and overall acceptability were evaluated. Each attribute was discussed and tests were initiated after panellists have been familiarized with the scales.

1: dislike very much, 2: dislike moderately, 3: dislike slightly, 4: neither like nor dislike, 5: like slightly, 6: like moderately, 7: excellently like it.

The purchase intention of fresh products was assessed as well by using a 5-point scale where;

1 = I would certainly buy, 2 = I would probably buy, 3 = maybe I would buy / not buy, 4 = I would probably not buy, 5 = I would certainly not buy.

2.2.4 DATA ELABORATION

Microsoft Excel 2013 spreadsheet was used in organising the raw data, calculating the mean and standard deviation and plotting a radar graph for sensory analysis.

3 RESULTS AND DISCUSSION

3.1 CARCASS WEIGHT

The mean live weight of the bird was 1192.93 ± 189.35g and the average carcass weight was 815.55 ± 153.80g. The mean carcass yield or dressed percentage was obtained at 68.37%. The live weight obtained in this study was almost the same as that of the reference [15], where they mentioned that, the average live weight of local chickens aged 35 weeks ranged from 1,200-1,500g. Reference [16] stated in their work that, broiler chickens with a harvest age of 30-35 days have a body-weight range of 1,500-2,000g. Sources of variation include broiler strain, age, sex, type of feed, maintenance management (cage density, presence or absence of access outside the cage) or natural conditions such as ambient temperature, humidity and air pressure [17]. The carcass yield was similar to those observed in ducks at 49 days [18].

3.2 MICROBIOLOGICAL ANALYSIS

The results of microbiological analysis were represented in Table 2. The Total Aerobic Mesophilic Flora Count was found to be 15.10^3 UFC / g in cooked sausage compared to uncooked sample (25.10^6 UFC / g). These microorganisms can provide a general indication of the microbiological quality of a food and will not make the difference between the natural microflora of a food, spoilage microorganism, added organisms to fermented food or pathogenic microorganism. According to the the Australia New Zealand Food Standards, a ready-to-eat foods in which all components are fully cooked for immediate sale or consumption has to have the total germ count < 10^4 UFC/g for good product and < 10^5 UFC/g for acceptable product [19]. In this study the cooking was applied in manner to obtain a product that can be subjected to the sensory analysis. That means our cooked sausage was acceptable and can be used for human consumption. In fact, it was reported that the value of the total plat count germs in chicken sausages retailed for sale in Iraq was $3.65.10^5$ UFC/g [20], which is unsatisfactory product according to Australia food authority (≥ 10^5 UFC/g). Reference [21] reported that all street vended food that they analysed had an acceptable aerobic plat count germ (≥ 10^3 et < 10^5 UFC/g). Enterobacteria and Escherichia coli were found to be 75 UFC/g and 40 UFC/g in cooked sausage respectively. According to reference [19] our cooked sausage was good for Enterobacteria (< 10^2 UFC/g) and acceptable for E. Coli (3 to < 10^2 UFC/g). That means the cooking process is efficient because the presence of both microorganisms at high value is due to the poor hygiene or inadequate heat treatment. However, it was reported that ready-to-eat samples from Iraq showed high quantity of E. Coli [20]. *Staphylococcus aureus, Salmonella* spp, ASR, Yeast and molds were not found in our cooked sausage. These results might suggest that our laboratory sausage would not affect the consumer's health. However, ready-to-eat samples were reported to contain *Staphylococcus aureus* and *Salmonella* spp [20].

Table 2. Results of microbiological analysis

Germ	Pasteurized sausage (UFC/g)	Unpasteurized sausage (UFC/g)
Total aerobic mesophilic germs	1.5×10^4	2.5×10^7
Enterobacteria	75	2×10^4
E. coli	40	3.5×10^4
Anaerobic Sulphite Reductors Germs	0	< 10
Staphylococcus aureus	0	0
Salmonella sp.	0	0
Yeast and Molds	0	1000

3.3 SENSORY EVALUATION ATTRIBUTES

Colour is an essential attribute in a food product because it appeals before consumers eat or buy the food product [22]. The mean score percentage indicated that 74.21% of the panellists moderately liked the colour of the sausage. In food products, especially meat products, the consumer often assesses the initial quality by their colour and appearance; These attributes are the primary indicators of perceived quality [23].

The **aroma** is defined as a stimulus produced by a food ingredient easily recognized by the sense of smell. The aroma can influence consumer's judgment, even before consuming foods [24]. In terms of aroma/favour 86.06% of the panellist liked the aroma excellently. Seasoning used in food production can also affect the level of **taste** [22]. A total mean score of 80.13% of the panellist accepted the taste and juiciness of the sausage. The different spices used specific intrinsic taste that was preferred by most people.

Texture looks at the granularity and consistency of the sausage. Average score percentage result was 62.36% panellists moderately accepting the texture of the sausage. This might be because the fat content in the local chicken meat was low and fat can maintain the stability of the emulsion, making sausage more elastic and softer [25]. Due to increase in the demand on low-fat frankfurters by customers, modified quantity of starches was utilized in this study for the purpose of "fat mimic" and this also follows the works of reference [26], who used modified starch in sausage processing to achieved the same agenda.

The **overall acceptability** parameter is the panellist's assessment of all sensory attributes: the colour, aroma, texture, and taste of sausage. The mean score percentage showed that 84.66% of the panellists accepted the local chicken sausage (local hotdogs). Therefore, we can conclude that the different ingredient and spices introduced during the processing of the sausage did not only serve as a preservative but enhance the taste, odour, colour and texture of the product. Customer's acceptability was based on these above mention attributes. Reference [27] did similar work on pork sausage using two African spices (white

pepper and ginger) and had a higher level of acceptability comparatively to the sausage without the spices. Our present study builds on existing evidence from many researches works, that a good combination of spices enhances the taste, aroma, colour and total acceptability of any food product.

Purchase Power Analysis Level: from the sensory evaluation carried out, the mean score percentage showed that 81% will buy the product with 55% saying they will certainly buy the product, 26% recorded they will probably buy. The rest of panellists (19%) said they might or might not buy. This gives us a partial understanding of how the product will be received in the market, therefore the rate of sausage importation could be reduced.

Fig. 1. Sensory evaluation Attributes

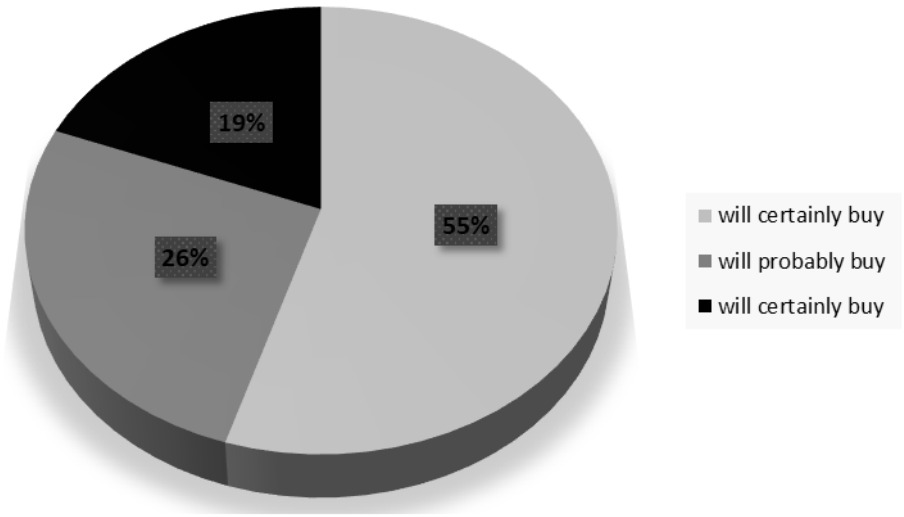

Fig. 2. Purchase power Analysis of the chicken Sausage

4 CONCLUSION

Using the natural preservatives, a low-fat chicken sausage was successfully processed in the laboratory. A standardized method of sausage formulation was achieved and this method can easily be adapted by firms and households. The African spices improved the taste, aroma, texture and appearance of the chicken sausage. The processed chicken sausage was highly appreciated and acceptable by consumers. The consumers declared that they will buy the new product.

REFERENCES

[1] FAO (2002). Global Production and Consumption of Animal Source Foods. Presented at the conference «Animal Source Foods and Nutrition in Developing Countries» held in Washington, D.C. June 24-26.

[2] FAO (2010). Poultry Meat and Eggs, agribusiness hand book. www.eastagri.org. Accessed on 4/3/2012.

[3] Kumar, P., Verma, A.K., Umaraw, P., Mehta, N. and Sazili, A.Q. 2022. Processing and preparation of slaughtered poultry. In Postharvest and Postmortem Processing of Raw Food Materials (pp. 300-314). Woodhead Publishing.

[4] Pearson, A.M., Gillett, T.A., Pearson, A.M. and Gillett, T.A. 1996. Sausages. Processed meats, pp.210-241.

[5] Cobos, A., & Díaz, O. (2015). Chemical composition of meat and meat products. Handbook of food chemistry, 1, 471-510.

[6] Venturini AC, AD Cavenaghi, CJC Castillo and EM Quiñones. 2011. Sensory and microbiological evaluationof uncured fresh chicken sausage with reduced fat content, Ciênc. Tecnol. Aliment., Campinas, 31: 629-634.

[7] Dave, D. and Ghaly, A.E., 2011. Meat spoilage mechanisms and preservation techniques: a critical review. American Journal of Agricultural and Biological Sciences, 6 (4), pp.486-510.

[8] Food and Drug Administration (FDA), U.S Department of Agriculture (USDA), Food Safety and Inspection Service (FSIS), Association of Food and Drug Officials (AFDO), U.S. 2014.

[9] Batiha, G.E.S., Hussein, D.E., Algammal, A.M., George, T.T., Jeandet, P., Al-Snafi, A.E., Tiwari, A., Pagnossa, J.P., Lima, C.M., Thorat, N.D. and Zahoor, M., 2021. Application of natural antimicrobials in food preservation: Journal Food Control, 126, p.108066.

[10] Bostsoglou, N.A., Grigoropoulou, S.M., Botsoglou, E., Govaris, A. and Papageorgiou, G. 2003. The effects of dietary oregano essential oil and α-tocopheryl acetate on lipid oxidation in raw and pasteurized turkey during refrigerated storage. Journal Meat Science. 65, 1193-1200.

[11] Bensid, A., Ucar, Y., Bendeddouche, B. and Ozogul, F. 2014. Effect of the icing with thyme, oregano and cloves extract on quality parameters of gutted and beheaded anchovy (Engraulis encrasicholus) during chilled storage. Journal Food Chemistry. 145, 681-686.

[12] Parisi, S., Delia, S., Ceccio, C., Crupi, D., Quartarone, F., & Laganà, P. (2010). Simplified Analysis Plans in accordance with the Regulation (EC) No. 1441/2007.

[13] Santé V, Fernandez X, Monin G and JP Renou. 2001. Nouvelles methods de mesure de la qualité de la viande de volaille. INRA Productions animals; 14 (4): 247- 254.

[14] White EC, Hanson HL, Klose AA and H Lineweaver. 2000. Evaluation of toughness differences in turkeys. Journal of Food Science; 29: 673-678.

[15] Sjofjan O, Djunaidi IH 2016. Pengaruh beberapa jenis pakan komersial terhadap kinerja produksi kuantitatif dan kualitatif ayam pedaging. Bull. Peternak., 40 (3): 187-192. https://doi.org/10.21059/buletinpeternak.v40i3.11622.

[16] Liani YA, Munthe IR, Irmayani D, Broto BE, Yanris GJ, Prasetya DA, Arifuddin R. 2021. The broiler chicken coop temperature monitoring use fuzzy logic and Lorawan. In 2021 3rd International Conference on Electronics Representation and Algorithm (ICERA): pp. 161-166. https://doi.org/10.1109/ICERA53111.2021.9538771.

[17] Fanatico AC, Pillai LC, Cavitt CM, Owens and Emmert JL. 2005. Evaluation of slower-growing broiler genotypes grown with and without outdoor access: Growth performance and carcass yield. Poultry Science., 84: 1321–1327. https://doi.org/10.1093/ps/84.8.

[18] Baltić, M. Ž., Starčević, M. D., Bašić, M., Zenunović, A., Ivanović, J., Marković, R.,... & Mahmutović, H. (2015). Effects of selenium yeast level in diet on carcass and meat quality, tissue selenium distribution and glutathione peroxidase activity in ducks. Animal Feed Science and Technology, 210, 225-233.

[19] Authority, N. F. (2009). Microbiological quality guide for ready-to-eat foods: a guide to interpreting microbiological results. NSW/FA/CP028/0906, 32, 08-017.

[20] Yassin, H. A. (2018). Microbiological evaluation of Sausages retailed for sale in Al Ramadi, Iraq. Journal of Advanced Pharmacy Education and Research, 8 (3-2018), 53-58.

[21] Asiegbu, C. V., Lebelo, S. L., & Tabit, F. T. (2020). Microbial quality of ready-to-eat street vended food groups sold in the Johannesburg Metropolis, South Africa. Journal of food quality and hazards control.

[22] Spence, C. (2015). Multisensory flavor perception. Cell, 161 (1), 24-35.

[23] Lawless, H. T. Heymann, H. 1999. Sensory evaluation of food: principles and practices. Gaithersburg: Aspen Publishers; p. 827.

[24] Ployon, S., Morzel, M., & Canon, F. 2017. The role of saliva in aroma release and perception. Journal of food chemistry, pp 226, 212–220.

[25] Adiaprana, R., Ma'ruf, W. F., & Anggo, A. D. 2016. Study of the stability quality of semi-refined carrageenan (SRC) and konjac flour emulsions in tilapia fish sausages (Oreochromis sp.). Journal of Fishery Product Processing and Biotechnology, 5 (1), 23–27.

[26] Keeton, J. T. 2001. Formed and emulsion products. In A. R. Sams (Ed.), Poultry meat processing (pp. 195e226). Boca Raton: CRC Press.
[27] Coleman, F. N. (2018). Evaluation of Selected Local Spices on Sensory and Microbial Characteristics of Fresh Pork Sausage (Doctoral dissertation, University of Ghana).