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Effect of Cooking Oil and Packaging Material on the Microbial Load of Rabbit Meat Floss

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ABSTRACT

The shelf life of processed food products is dependent on the interplay of several factors which include packaging and ingredients used in producing such foods among others. In this study, meat floss was produced from rabbit meat obtained from Chinchilla breed using three commonly available cooking oils: Refined palm oil (RPO), Soya Oil (SO) and Canola Oil (CO). The resulting Rabbit Meat Floss (RMF) were packed in three materials: Aluminium Foil (AF), Ziploc (ZPL) and Polypropylene (PP). The RMF were stored at room temperature and analysed for microbial load (*log10-*^{5}cfu/g) on days 7, 14 and 21 of storage. The study was a 3 x 3 factorial experiment fitted into a completely randomized design replicated three times. Interacting with storage days ZPL had significantly lower ($p<0.05$) microbial load throughout the duration of the experiment with the lowest value of 2.6*log10-*^{5}cfu/g on day 7. For cooking oil type-storage days interaction, RMF with SO had the lowest microbial load of 1.3*log10-*^{5}cfu/g on day 7 while RMF with RPO had the lowest microbial loads on days 14 and 21. Overall RMF with RPO stored in ZPL consistently had the lowest microbial loads throughout the duration of the study.

Keywords: Aluminium foil, Canola oil, Polypropylene, Refined palm oil, Soya oil

INTRODUCTION

Meat is a nutritious and valuable food which makes it an ideal medium for microorganisms and provides a suitable environment for the growth and proliferation of meat spoilage microorganisms and common food-borne pathogens (Adzitey *et al*., 2010). The high nutrients and moisture content make meat prone to spoilage that can be prevented by value addition (Anna *et al*., 2005). This involves all the processes involved in prolonging the shelf-life of meat. Meat left unprocessed or untreated will spoil within several hours or days. Dehydration is one of the first forms of meat preservation (Kassim and Omojola, 2020), either by sun-drying, smoking, and deep frying for products such as meat floss. The need for meat processing is as a result of the need to preserve meat (Vandendriessche, 2008) and increase the shelf life.

Meat processing is the production of meat products from lean meat, animal fat and certain non- meat additives. Unlike prehistoric times meat processing does not just serve to increase shelf life, it also enhances flavour, appearance and nutritional quality of the product. Meat processing can create meat products from all edible livestock parts including the lean meat which is made tastier, more attractive, nourishing and shelf-stable, making the product last longer periods without refrigeration at room temperature such as meat floss. The shelf life of processed meat products is often influenced by other factors apart from processing method employed, like oil type, packaging, artificial preservatives and their interactions (Mihaela *et al*., 2010).

Meat floss spoilage is usually caused by the unavoidable contamination and subsequent decomposition of the product by microbes borne on the product itself, or from the handlers of the product and their implements (Shakuntala and Shadak, 2001).This leads to the reduction of nutritive value and increased risk of food borne infections but these can be mitigated with the right storage or packaging material. The ideal storage material should maintain the appearance of the meat floss during storage, delay microbial spoilage and oxidation.

Therefore this study was designed to evaluate the influence of cooking oil and packaging materials on the microbial load and shelf life of rabbit meat floss during storage.

MATERIALS AND METHODS

Experimental Site

This experiment was carried out at the Department of Animal Science, University of

Ibadan, Nigeria, in the Animal products and processing laboratory.

SAMPLE COLLECTION

Twelve unsexed and mature chinchilla rabbits were purchased from a reliable source in Ibadan, Oyo State. The rabbits were fasted and rested before slaughtering. The slaughtering was done under hygienic conditions in the Animal products and processing laboratory of the Department of Animal Science using the kosher means of slaughtering. After slaughter, the rabbits were hoisted for efficient bloodletting by gravitational force and the pumping effect of the heart. The rabbits were skinned, eviscerated, trimmed of excess fat and deboned. Samples for the determination of water holding capacity, thermal shortening and cooking loss were collected randomly and the parameters were determined.

MEAT FLOSS PREPARATION

This involved all the steps involved in the conversion of the carcass to the final product which is the meat floss such as spice mixture preparation, meat preparation, cooking, shredding, frying, de-oiling (draining of excess oil) and packaging.

SPICE MIXTURE PREPARATION

Two spice mixtures were prepared, Cooking Recipe and Shredding Recipe, shown in Table 1 and Table 2 below. The spice mixtures were the cooking recipe and the shredding recipe as shown in the table. The recipe was formulated/prepared based on previous work by Kassim and Omojola (2020) where a similar recipe was used in the production of meat (beef) floss. All the ingredients for the spice mixture were locally sourced from a well patronized open market. Each ingredient was pulverized, measured and thoroughly mixed as needed for each of the two recipes. The cooking and shredding recipes were kept separate in airtight plastic containers until used.

COOKING PROCESS

The already cleaned meat was put into a pot and placed on the gas burner for cooking and the cooking recipe was added in the ratio of 1g of spice to 100g of meat. 80g of spice was added in total to the meat (8 kg), thinly sliced fresh onions of 800g (approximately 80 g on a dry matter basis) were added and water was added in the ratio of 25cl to 1000g of meat.

The meat was cooked until the broth dried in the meat ensuring the meat was properly cooked for about 40 minutes. The meat samples were removed and allowed to cool at room temperature before weighing.

SHREDDING PROCESS

The cooked and cooled meat samples were shredded by pounding with a local mortar and pestle. The shredding recipe was added in the ratio of 50g of spice to1000g of meat. These were weighed and added a little at a time as pounding progressed to ensure proper and uniform mixing of the recipe. The pounding was intense and consistent until the meat strands disengaged and were beaten to shreds. After shredding the meat was weighed and separated into three equal parts for frying in the different oil types.

FRYING PROCESS

The shredded meat was separately deep-fried in three different oil types namely; Refined palm oil, Soya oil and Canola oil which were preheated to 180ºC (the ratio of oil to meat was 1 litre to 1000g of meat). The meat samples were fried until a golden brown colouration was obtained.

DRAINING OF EXCESS OIL

After frying each batch of shredded meat until golden brown, the products were poured into a colander and pressure was applied to oil, the product was later transferred into a cheese cloth where it was pressed with clean, washed and dry hands to remove more of the excess oil to prevent the final product from sticking together. The meat floss from each oil type was poured into separately marked trays, allowed to cool and separated into strands.

Table 1: Composition of the cooking recipe used for meat floss production (g/100g)

Ingredients/seasoning	**Scientific/Botanical names**	**Quantity (g/100g)**
Salt	Sodium Chloride	10.00
Maggi	Maggi	15.00
Thyme	*Thymus vulgaris L.*	12.50
Curry	*Murraya koenigii (L.) Spreng.*	12.50
Onions	*Allium cepa L. var. cepa*	50.00
Total		**100.00**

Source: Kassim and Omojola (2020) * All botanical names according to Rehm and Espig (1991)

Table 2: Composition of shredding recipe used for meat floss production (g/100g)

Ingredients/seasoning	Scientific/Botanical names	Quantity (g/100g)
Red Pepper	*Piper nigrum* L.	35.00
Maggi	Maggi	30.00
African Nut Meg	*Monodora myristica* (Gaertn.) Dunal	2.50
Ginger	*Zingiber officinale Rosc*.	4.00
Garlic	*Allium sativum* L	3.00
Cloves	*Syzygium aromaticum* (L.) Merr. et L.M.Perry	2.50
Curry powder	*Murraya koenigii* L.	3.50
Thyme leaves	*Thymus vulgaris* L.	2.50
Salt	Sodium Chloride	5.00
Onions	*Allium cepa* L. var. cepa	12.00
Total		100.00

Source: Kassim and Omojola (2020) * All botanical names according to Rehm and Espig (1991)

MICROBIAL LOAD COUNT DURING STORAGE

The meat floss samples based on cooking oil type used were divided into three equal parts, packaged in polypropylene, aluminium foil and Ziploc bags and stored for 21 days. The microbial loads were determined on days 7, 14 and 21 of storage thus, 28g of Nutrient Agar was dissolved in 500cm^3 of distilled water and boiled in a water bath for 30 minutes. The medium was then cooled to 45°C before pouring into the plate under sterilized conditions for culturing bacteria. 1g of each sample was dissolved in 9mls of sterilized water in test tubes and serially diluted up to 10^{-5}.

Sterile pipettes were used to measure 1cm^3 out of the 10^{-3} and 10^{-5} dilution fractions and these were pipetted into two different labelled sterile Petri dishes and molten agar at 45°C was poured to it (using pour plate method). It was swirled gently by hand for even distribution; the plates were inverted and incubated in an incubator at 37°C for 24 hours. After which they were examined under a microscope. Colonies that appeared at the end of the incubation period were counted and the data was expressed as logarithms of the colonies forming unit (log_{10}CFU/g) sample. All analyses were done in triplicates following the procedures described by (Seydim and Sarikus, 2006)

STATISTICAL ANALYSIS

The experiment was a 3 x 3 factorial study fitted into a completely randomized design. All data obtained were subjected to statistical analysis using SAS2000 package while means were separated with Duncan Multiple Range Test. Statistical significance was set at $P < 0.05$.

RESULTS

Effect of storage days and packaging materials on the microbial count of rabbit meat floss

The effect of storage days and packaging materials on the microbial count *(log10-*^{5}cfu/g) of rabbit meat floss is shown in Table 3 below. The result showed significant variation ($P<0.05$) between the interactions.

On day 7, meat floss packed in aluminium foil (2.6 *log10-*^{5}cfu/g) had the highest value and was significantly different ($P<0.05$) from those packed in polypropylene (2.5 *log10-*^{5}cfu/g) which was also significantly different from those packed in Ziploc (2.0 *log10-*^{5}cfu/g) which had the least value.

This trend was similar to observations on days 14 and 21, although there was a general increment in microbial load as storage days increased.

Table 3: The effect of storage days and packaging materials on the microbial count (log10-^{5}cfu/g) of rabbit meat floss

Day	Packaging material	Microbiological count log10^{-5}cfu/g
7	Polypropylene	2.5^b
	Aluminium foil	2.6^a
	Ziploc	2.0^c
14	Polypropylene	4.5^a
	Aluminium foil	4.0^b
	Ziploc	2.7^c
21	Polypropylene	5.1^a
	Aluminium foil	4.5^b
	Ziploc	4.1^c

^{a,b,c} Means with the same superscript are not significantly different ($P>0.05$)

Effect of storage days and cooking oil type interaction on microbial count

The effect of storage days and oil type interaction on microbial count (*log10-*^{5}cfu/g) of rabbit meat floss is shown in Table 4. There was significant difference (P<0.05) between the interactions.

On day 7, meat floss from refined palm oil had the highest microbial count of 27 *log10-* ^{5}cfu/g, followed by canola oil at 1.6*log10-*^{5}cfu/g, and soya oil being the least. On day 14, meat floss from canola oil had the highest microbial count of 4.7 *log10-* ^{5}cfu/g which was significantly than for refined palm oil and soya oil.

At 21, meat floss from canola oil (5.2*log10-*^{5}cfu/g) and soya oil (5.1*log10-*^{5}cfu/g) were not significantly different (P>0.05) but both were significantly higher than refined palm oil (3.5 *log10-*^{5}cfu/g) which had the least value.

Table4: The effect of storage days and oil type interaction on microbial count (log10^{-5}cfu/g) of rabbit meat floss

Day	Cooking oil type	Microbial count(log10^{-5}cfu/g)
7	Refined palm oil	2.7^{a}
	Canola oil	2.7^{a}
	Soya oil	1.7^{b}
14	Refined palm oil	3.1^{c}
	Canola oil	4.7^{a}
	Soya oil	3.4^{b}
21	Refined palm oil	3.5^{b}
	Canola oil	5.2^{a}
	Soya oil	5.1^{a}

^{a,b,c} Means with the same superscript are not significantly different (P>0.05)

Effect of storage days, cooking oil type and packaging material interaction on microbial count of rabbit meat floss

The effect of storage days, cooking oil types and packaging material interaction on microbial count (*log10-*^{5}cfu/g) on rabbit meat floss is shown in Table 5. The interactions show significant variations (P<0.05).

On day 7, meat floss from refined palm oil packaged in polypropylene had the highest value of 3.5*log10-*^{5}cfu/g while meat floss from refined palm oil packaged in Ziploc had the least microbial count of 1.8*log10-*^{5}cfu/g among all the oil-package type combinations.

Similar trend was observed for days 14 and 21 along with a general increment in microbial load. However, on day 21 meat floss from refined palm oil packaged in Ziploc had the lowest microbial load of 2.5*log10-*^{5}cfu/g across all oil-package type combinations and days.

Table 5: The effect of storage days, cooking oil types and packaging material interaction on microbial count ($log10^{-5}$cfu/g) on rabbit meat floss

Days	Cooking oil type	Packaging Material	Microbial count ($log10^{-5}$ cfu/g)
7	Canola oil	Aluminium foil	3.2^{b}
		Polypropylene	2.2^{d}
		Ziploc	2.8^{c}
	Refined palm oil	Aluminium foil	3.3^{ab}
		Polypropylene	3.5^{a}
		Ziploc	1.4^{g}
	Soya oil	Aluminium foil	1.5^{fg}
		Polypropylene	1.9^{ed}
		Ziploc	1.8^{ef}
14	Canola oil	Aluminium foil	4.8^{ab}
		Polypropylene	5.2^{a}
		Ziploc	4.1^{dc}
	Refined palm oil	Aluminium foil	3.7^{d}
		Polypropylene	3.7^{d}
		Ziploc	1.8^{e}
	Soya oil	Aluminium foil	3.6^{d}
		Polypropylene	4.5^{bc}
		Ziploc	2.2^{e}
21	Canola oil	Aluminium foil	5.2^{b}
		Polypropylene	5.8^{a}
		Ziploc	4.5^{c}
	Refined palm oil	Aluminium foil	4.1^{dc}
		Polypropylene	3.9^{d}
		Ziploc	2.5^{e}
	Soya oil	Aluminium foil	4.0^{d}
		Polypropylene	5.8^{a}
		Ziploc	5.5^{ab}

^{a,b,c,d,e,f,g} Means with the same superscript are not significantly different (P>0.05)

DISCUSSION

Packaging is an essential component of food processing and merchandising, which more than just providing aesthetic appeal is intended to extend the shelf life of foods for optimal periods (Zakrys *et al*., 2009, Gómez and Lorenzo, 2012).

From this study storage days and package type interaction showed Ziploc (a polyethylene low density material) as being least favourable to the growth of microbes in meat floss over a period of 21days. This observation is in agreement with reports by (Kassim and Omojola, 2020) that polyethylene packaged beef floss had the least microbial load among other packaging materials tested in their study over a period of 21 days. However, the figures reported for microbial load in this study were higher which could be due to variation in processing methods and meat type used.

The antimicrobial effects of some edible oils have been noted due to bioactive compounds inherent in them (Shoaib *et al.*, 2014; Xuan *et al.*, 2018). For the effects of interaction between storage days and cooking oil types, refined palm oil had the strongest reducing effect on microbial growth at days 14 and 21 of storage. This observation is also in agreement with findings by (Kassim and Omojola, 2020) who reported least microbial growth in beef floss prepared with palm oil, compared to soya oil and groundnut oil. But this is at variance with (Ekwenye and Ijeomah, 2005) who reported that palm oil had no antimicrobial effect on its own.

When interaction of storage days, cooking oil type and packaging material were considered together, the combination of refined palm oil and Ziploc consistently had the lowest microbial load amount all cooking oil type-packaging throughout the duration of this study. This might not be unrelated to the low polyunsaturation and high antioxidant status of palm oil(Aluyor and Oboh, 2014; Tan and Nehdi, 2012) which leaves little or no room for oxidation and microbial action along with the more veritable airtight environment guaranteed by Ziploc compared to other packaging materials used in this study. All microbial loads recorded in this study were within satisfactory limits for dried meat products as prescribed by FSANZ (2001).

CONCLUSION

Results obtained in this study indicate that for preserving shelf life, particularly with respect to inhibition of microbial growth in rabbit meat floss, frying the meat floss with palm oil and packaging in Ziploc bags might be more advisable. However, further research is necessary to clarify the types of microbes that survive best in each oil type-package material combinations for a better understanding of optimal modes of deploying them to reduce microbial contamination in meat products.

REFERENCES

Adzitey, F., Teye, G. A., Ayim, A. G. and Addy, S. (2010). Microbial quality of Chevon and mutton sold in Tamale metropolis of Northern Ghana. *Jour. Applied Sci. and Environ. Mgt. 14 (4): 53-55.*

Aluyor, E. O., and Oboh, I. O. (2014). PRESERVATIVES | Traditional Preservatives – Vegetable Oils. In C. A. Batt & M. L. Tortorello (Eds.), *Encyclopedia of Food Microbiology* 2nd Ed., Academic Press. pp. 137–140. https://doi.org/10.1016/B978-0-12-384730-0.00263-9

Anna, A. M., Lackshmannan, V., Mendiratta, S. K., Anjaneyulu, A. S. R., and Bisht, G. S. (2005). Development and quality characteristics of extruded tripesnack from buffalo rumen meat and corn flour. *Journal Food Science Technology 42:263-267.*

Ekwenye, U. N., and Ijeomah, C. A. (2005). Antimicrobial Effects of Palm Kernel Oil and Palm Oil. *Current Applied Science And Technology*, *5*(2), 502–505.

Food Standards Australia New Zealand (2001). Guidelines for the micobiological examination of ready-to-eat foods. Retrieved December 17, 2020 from, http://www.foodstandards.gov.au/srcfiles/Guidelines%20for%20Micro%20exam.pdf

Gómez, M. and Lorenzo, J. M. 2012. Effect of packaging conditions on shelf-life of fresh foal meat. *Meat Science* 91: 513–520.

Kassim, O. R. and Omojola, A. B (2020). Effects of cooking oils and packaging media on quality of meat floss. *Nigerian Journal of Animal Production*, 47(3):323 – 335.

Kassim, O., and Omojola, A. (2020). Effects of cooking oils and packaging media on quality of meat floss. *Nigerian Journal of Animal Production*, *47*, 323–335. https://doi.org/10.51791/njap.v47i3.170

Mihaela, G., Mira, T., George, B., Petru, N., and Vasilica, S. (2010). Nutritional and health aspects related to frying (1). *Romanian Biotechnology Letters 15 (6): 5675-5682.*

Rehm, S. and Espig, G. (1991). The cultivated plants of the tropics and subtropics. Verlag Josef margrave/CTA. p. 552.

Seydim, A. C., and Sarikus, G. (2006). Antimicrobial activity of whey protein based edible films incorporated with oregano, rosemary and garlic essential oils. *Food Research International*, *39*(5), 639–644. https://doi.org/10.1016/j.foodres.2006.01.013

Shakuntala, N. M. M., and Shadak, S. (2001). Food Facts and Principles 2nd Edition Published K.K Gupta for Bassir New Age Inter (P) Ltd. Pp2 – 4.

Shoaib, A., Saeed, G., and Ahmad, S. (2014). Antimicrobial activity and chemical analysis of some edible oils (clove, kalonji and taramira). *African Journal Of Biotechnology*, *13*, 4347–4354. https://doi.org/10.5897/AJB2014.13683

Tan, C.-P., and Nehdi, I. A. (2012). 13—The Physicochemical Properties of Palm Oil and Its Components. In O.-M. Lai, C.-P. Tan, & C. C. Akoh (Eds.), *Palm Oil*. AOCS Press. pp. 377–391. https://doi.org/10.1016/B978-0-9818936-9-3.50016-2

Vandendriessche, F. (2008). Meat products in the past, today and in the future. *Meat Sci. 78:104– 113*

Xuan, T. D., Gangqiang, G., Minh, T. N., Quy, T. N., and Khanh, T. D. (2018). An Overview of Chemical Profiles, Antioxidant and Antimicrobial Activities of Commercial Vegetable Edible Oils Marketed in Japan. *Foods*, *7*(2), 21. https://doi.org/10.3390/foods7020021

Zakrys, P. I., O'Sullivan, M. G. Allen, P. and Kerry, J. P (2009). Consumer acceptability and physiochemical characteristics of modified atmosphere packed beef steaks. *Meat Science* 81: 720–725.