Keeping Quality of Rabbit Meat Floss Prepared with Different Oils and Stored in Three Packaging Materials

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Abstract

Introduction: Meat floss is a dehydrated ready-to-eat meat product most commonly produced from beef. Due to increasing consumer awareness about health, there is interest in healthier alternatives like rabbit meat.

Materials and methods: In this study, meat floss was produced from rabbit meat using three cooking oils: Refined Palm Oil (RPO), Soya Oil (SO) and Canola Oil (CO). The iodine number of each of the three oil types was determined before use. The resulting Rabbit Meat Floss (RMF) was packed in three materials: Aluminium Foil (AF), Ziploc (ZPL) and Polypropylene (PP). The RMF were stored at room temperature and analysed for sensory properties and Thiobarbituric acid reactive substances (TBARS) on days 7, 14 and 21 of storage. The study was a 3 by 3 factorial experiment fitted into a completely randomised design and replicated three times.

Results: The refined RFO had the highest iodine number (81.05), and CO had the least (69.57). Following interactions among storage days, oil type and packaging material, TBARS was significantly highest ($P<0.05$) on day 7 for RMF from CO stored in ZPL (8.44mgMDA/Kg). The RMF from SO stored in AF had the lowest TBARS at Day 21 (2.57mgMDA/Kg).

Conclusion: There were no significant differences in sensory properties throughout the experimental period.

Keywords: Rabbit Meat, Soya Oil, Canola Oil, Refined Palm Oil

Introduction

Meat is the edible part of the skeletal muscle of an animal that is healthy at the time of slaughter (1). It is composed chemically of four major components, water, protein, lipid, carbohydrate, and other minor components such as vitamins, enzymes, pigments and flavour compounds (1,2). However, because of its unique biological and chemical nature, meat undergoes progressive deterioration from the time of slaughter until consumption (3,4).

Fresh meat is considered one of the most perishable foods. Therefore, preservation measures must be applied promptly after slaughter. Meat processing and preservation involves the application of measures that would delay or prevent certain changes that make meat more unusable as food or downgrade some quality aspects. The pathways by which such deterioration takes place are diverse and include microbial, chemical and physical processes.

Meat processing adds value to final products. The value-added meat products display specific flavour, taste, colour or texture components that differ from fresh meat (5). Some of these processing methods also alter the flavour and texture of meat, which inevitably can increase its value when the products are sold (6).

Meat floss is a processed dried meat product with good nutritive value and varying shelf stability at room temperature, which the general public can consume as a snack or in combination with other foods as a protein source in their daily diet. Meat floss has a light and fluffy texture, easy-to-pack and without any reheating or further preparation (7). It is commonly produced from beef and pork.

The varying shelf stability at room temperature of meat floss has always been linked to the storage material and oil type used in the production of the meat floss because the product is stored at room temperature, which is suitable for the proliferation of microbes. Hence, the storage material acts as a barrier against further contamination and provides an environment that slows the growth and reproduction of the microorganisms. The oil type influences the shelf-life because the oil is absorbed and becomes part of the product (8). Oil type also affects oxidation causing harmful changes in foods due to lipid oxidation such as loss of flavour or production of off flavours, loss of colour, nutrient value, and accumulation of compounds, which may be harmful to consumers (9).

Rabbit meat is not as popularly consumed as beef and pork, but due to its low fat, low cholesterol and low sodium contents, and being a rich source of the B vitamins alongside other nutritional benefits, it has started to gain ground, especially in developing countries like Nigeria (10–12). The main objective of manufacturers of processed ready-to-eat meat products aims at producing economically accepted products that are microbiologically safe, of high organoleptic quality, and of an acceptable standard. Therefore, this study was designed to evaluate the effect of different cooking oils and packaging materials on the keeping quality of rabbit meat floss.

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. They were slaughtered 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 determining 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: the cooking and shredding, as shown in table 1 and 2 were used in this process. The recipe was formulated/prepared based on previous work by (13), 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-patronised open market. Each ingredient was pulverised, 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

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 (8kg), thinly sliced fresh onions of 800g (approximately 80g 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 adequately cooked for about 40 minutes. The meat samples were then removed and allowed to cool at room temperature before weighing.

Shredding

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 to 1000g 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

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 applied. The product was later transferred into a cheesecloth where it was pressed with clean, washed and dried hands to remove more excess oil and 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.

Storage

Each of the rabbit meat floss types fried with the different oils was divided into three equal parts, and each part was stored at room temperature in one of three packaging materials; Aluminium foil, Polypropylene, and a Ziploc bag. Afterwards, the stored meat floss was evaluated for lipid oxidation and sensory properties on the 7th, 14th, and 21st days of storage.

Keeping Quality Analyses

Oxidative Rancidity

This was evaluated using the modified method described by Wetti *et al.,*(15). 1g of sample was weighed into a test tube and homogenised with 2mls of distilled water. 2.5mls of Trichloroacetic acid (TCA) was added to each test tube and centrifuged at 2000 revolutions per minute for 10 minutes. 1ml of the centrifuged sample was decanted into a test tube, and 1ml of Thiobarbituric acid (TBAR) was added to the test tubes. The mixture was further boiled for 35mins and poured into a curvet. A UV-VIS spectrophotometer was used to read the samples at 532nm wavelength. The results were expressed as mg malondialdehyde(MDA)/kg sample.

Sensory Analysis

This was evaluated by panellists consisting of a 15-member semi-trained panel, according to the procedures of AMSA (16). They comprised both male and female from undergraduate and postgraduate students of the Department of Animal Science, at the University of Ibadan. The panellists were given unsalted cracker biscuits and water to clean their mouths between tasting rabbit meat floss samples. On a clean saucer, the panellists were presented with rabbit meat floss from various oil types in a sequential fashion.

Each treatment's meat floss was evaluated independently of the other. The panellists rated colour, flavour, tenderness, ropiness, juiciness, texture, and overall acceptabilityon a 9-point hedonic scale.

Experimental Design and Statistical Analysis

The experiment was a 3 by 3 factorial experiment fitted into a completely randomised design.

All data obtained were subjected to statistical analysis using SAS 2000 package, while means were separated with Duncan Multiple Range Test. Statistical significance was set at $P<0.05$.

Results

Iodine values of different oil types used in the production of rabbit meat floss and product yield from eating oil type

The iodine values of the different oil types used in the production of rabbit meat floss are shown in Table 3. The iodine value of refined palm oil (81.05%) was significantly higher ($P<0.05$) than that of soya oil (76.79%), which was also significantly higher ($P<0.05$) than that of canola oil (69.57%). Product yield was highest was highest for rabbit meat floss produced with soya oil (74.10), followed by refined palm oil (63.25) and canola oil (59.65). *(See table 3)*

Effect of Storage Days and Packaging Material on TBARS Substances of Rabbit Meat Floss

The effect of storage days and packaging material on the TBARS substance of rabbit meat is shown in Table 4. The result showed significant variations (P<0.05) of the interactions between cooking oil type and packaging material. The highest value was from the interaction between day 7 and Aluminium foil (7.22mgMDA/Kg), which was not significantly different (P>0.05) to the interaction between day 21 and Ziploc (7.01mgMDA/Kg), but the last interaction above was not significantly different (P>0.05) from that of day 7 and Ziploc (6.50mgMDA/Kg).

On days 7 and 14, Aluminium foil showed significantly higher (P<0.05) lipid oxidation (7.22 mg MDA/Kg) and 5.77 mg MDA/Kg) than other packaging materials. While at day 21, Ziploc took over, having significantly higher (P<0.05) TBARS of 7.01mgMDA/Kg. *(See table 4)*

Effect of Storage Days and Oil Type on TBARS Substances of Rabbit Meat Floss

The effect of interactions between days of storage and oil type on TBARS(mg MDA/Kg) is shown in Table 5. Significant differences (P<0.05) were observed across all intervals, and the highest values were all recorded on day 7, with canola being the highest (8.12mgMDA/Kg), followed by refined palm oil (6.97mgMDA/Kg) and soya oil (4.69mgMDA/Kg). There was a general decline as storage days increased, and soya oil consistently had the least TBARS across all intervals. *(See table 5)*

Effect of Storage Days, Cooking Oil Type and Packaging Material Interactions on the TBARS Substances of Rabbit Meat Floss

The effect of storage days, cooking oil type, and packaging material interactions on the TBARS substances of rabbit meat floss is shown in Table 6. Significant differences (P<0.05) were observed across all intervals, and the highest values were recorded on day 7.

On day 7, rabbit meat floss from canola oil stored in a Ziploc bag had the highest (P<0.05) TBARS of 8.44mgMDA/Kg, followed by rabbit meat floss from refined palm oil stored in aluminium foil at 8.13mgMDA/Kg. Rabbit meat floss from soya oil stored in the three different packages had the lowest TBARS values, with the one stored in polypropylene having the least value of 4.13mg/100mg.

A similar trend was observed for days 14 and 21, with the rabbit meat floss from soya oil having the consistently least TBARS and a general decline in TBARS values across the oil and package types. *(See table 6)*

Effect of Storage Days, Oil Type and Packaging on the Sensory Properties of Rabbit Meat Floss

The results of the sensory evaluation of rabbit meat floss, based on the interaction of days of storage, cooking oil types, and packaging materials as assessed by the panellists, are shown in Table 7. There were no significant differences (P>0.05) according to the panellists ratings on days 7, 14, and 21 for rabbit meat floss prepared with canola oil, soya oil and refined palm oil and stored using aluminium foil, Ziploc bag, and polypropylene as a storage material for aroma, flavour, taste, and juiciness, ropiness, and overall acceptability. *(See table 7)*

Discussion

Iodine value is the measure of the degree of unsaturation of oil, which is the weight of iodine absorbed by 100g of the oil expressed in percentage. Therefore, the higher the iodine value, the higher the degree of unsaturation, meaning the oil contains more polyunsaturated fatty acids (17), the iodine values of the three oils used in this study showed that canola oil had the least value of 69.57%, then soya oil (76.79%) and refined palm oil (81.05%). The values for soya oil and palm oil are higher when compared to the iodine values for soya oil and palm oil (36.17 and 28.00%) as obtained by Kassim et al., (13). This observation could be due to differences in the production processes of the utilised oils.

The thiobarbituric acid reactive substances (TBARS) values have been commonly considered a lipid rancidity index. The quantitative production of malonaldehyde during fat oxidation in stored food is responsible for TBARS values. The level of malondialdehyde generated in meat or stored meat products can be determined using the TBARS assay (18).

Lipid oxidation is a very important event impacting the quality of foods, especially those containing highly unsaturated fats. Quality losses, unpalatable flavour and odour production, shortening of shelf life, losses of nutritional values (e.g. loss of polyunsaturated fatty acids, PUFAs) and possible production of unhealthy molecules are some of the extensive consequences of lipid oxidation in foods (19).

In this study, TBARS values indicating levels of lipid oxidation recorded were generally higher than for similar studies by Kassim et al. FAO (13,20), where beef was used in producing meat floss. This observation is likely due to the kind of meat used in floss production, as rabbit meat is higher in unsaturated fatty acids that are more easily oxidised (11); also, the iodine values of oils used in this study were higher than for the other studies.

As storage days increased, there was a general decline in TBARS recorded with respect to interaction between packaging materials and storage days, contrary to observations in earlier studies by Kassim et al., and Bujang et al.,(13,21). However, no consistent pattern was observed as polypropylene had the lowest TBARS on day 7, Ziploc had the lowest on day 14, and aluminium foil had the lowest on day 21.

With respect to interaction between oil type and storage days, there was a general decline in TBARS values as storage days increased. The highest values for TBARS were recorded on the day for canola oil (8.12) and refined palm oil (6.97), while soya oil which consistently recorded the lowest TBARS, had its highest value on day 21 with a value of 4.94. This was in contrast to observations by Kassim et al., (13), where beef floss from soya oil consistently had higher TBARS than other oil types used in that experiment. The reasons for these are likely due to different iodine values and production methods of oils used in the different experiments.

When the effects of interactions of storage days, cooking oil type, and packaging materials on TBARS were considered together, a similar general decline in TBARS from day 7 through 21 was observed. Soya oil combination with aluminium foil had the lowest TBARS (2.57) on day 21 among all oil and package type combinations. This is similar to the inference reported by Wijayanti et al., (22), who observed that aluminium foil packaging preserved the quality of fish floss better over a period of 80days.

There were no significant differences among the oil types and package combinations for all the sensory parameters across all storage intervals. However, by day 21, soya oil in combination with polypropylene had higher acceptability. The acceptability of the rabbit meat floss was above average throughout the duration of the experiment.

Conclusion

It was observed that rabbit meat floss produced with soya oil consistently had the lowest TBARS throughout the duration of this study, especially when packaged in aluminium foil. This indicates that soya oil is recommended for producing rabbit meat floss, and packaging such as aluminium foil is also recommended. However, supplemental antioxidants should be considered in the production of rabbit meat floss to better suppress lipid oxidation.

Conflict of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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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 (14)

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 (14)

Table 3: The Iodine Values of the Different Oil Types used in the Preparation of Rabbit Meat Floss and Product Yield from each Oil Type

	Oil types			
Parameters	**Refined palm oil**	**Canola oil**	**Soya oil**	**SEM**
Iodine values(%)	81.05±0.01[a]	69.57±0.02[c]	76.79±0.03[b]	0.04
Product Yield (%)	63.25	59.65	74.10	

[a,b,c] Means with the same superscript are not significantly different (P>0.05)

Table 4: The Effect of Storage Days and Packaging Material on the TBARS Values of Rabbit Meat Floss

Days	**Packaging material**	**TBARS(mg MDA/Kg)**	***SEM***
7	Aluminium foil	7.22±1.42[a]	0.13
	Ziploc	6.50±1.77[bc]	0.13
	Polypropylene	6.06±1.65[cd]	0.13
14	Aluminium foil	5.77±1.99[de]	0.13
	Ziploc	4.74±0.50[f]	0.13
	Polypropylene	5.23±1.35[fe]	0.13
21	Aluminium foil	5.20±2.06[fe]	0.13
	Ziploc	7.01±0.47[ab]	0.13
	Polypropylene	5.42±0.51[e]	0.13

[a,b,c,d,e,f] Means with the same superscript are not significantly different (P>0.05)

Table 5: Effect of Storage Days and Oil Type Interaction on the TBARS Substances of Rabbit Meat Floss

Days	Cooking oil type	TBARS*(mg MDA/Kg)*	SEM
7	Canola oil	8.12[a]	0.13
	Refined palm oil	6.97[b]	0.13
	Soya oil	4.69[d]	0.13
14	Canola oil	6.58[bc]	0.13
	Refined palm oil	5.15[d]	0.13
	Soya oil	4.02[e]	0.13
21	Canola oil	6.31[c]	0.13
	Refined palm oil	6.37[bc]	0.13
	Soya oil	4.49[d]	0.13

[a,b,c,d,e] Means with the same superscript are not significantly different (P>0.05)

Table 6: The Effect of Storage Days, Cooking Oil Type and Packaging Material Interactions on TBARS Substance (mg MDA/Kg) of Rabbit Meat

Days	Cooking oil type	Packaging material	TBARS(mg MDA/Kg)	SEM
7	Canola oil	Aluminium foil	8.12±0.22[abc]	0.15
		Ziploc	8.44±0.15[a]	0.10
		Polypropylene	7.80±0.17[abcd]	0.12
	Soya oil	Aluminium foil	5.42±0.46[hijk]	0.33
		Ziploc	4.53±0.52[jkl]	0.36
		Polypropylene	4.13±0.01[kl]	0.00
	Refined palm oil	Aluminium foil	8.13±0.21[ab]	0.15
		Ziploc	6.53±0.35[defghi]	0.24
		Polypropylene	6.23±0.21[efghi]	0.15
14	Canola oil	Aluminium foil	8.10±0.15[abc]	0.10
		Ziploc	4.75±0.27[jkl]	0.19
		Polypropylene	6.90±0.71[bcdef]	0.51

	Soya oil	Aluminium foil	3.67±0.10^{lm}	0.07
		Ziploc	4.22±0.15^{kl}	0.11
		Polypropylene	4.17±0.21^{kl}	0.15
	Refined palm oil	Aluminium foil	5.55±0.19^{ghij}	0.13
		Ziploc	5.25±0.33^{ijk}	0.23
		Polypropylene	4.65±0.29^{jkl}	0.20
21	Canola oil	Aluminium foil	6.44±0.03^{efghi}	0.02
		Ziploc	6.73±0.25^{defg}	0.18
		Polypropylene	5.76±0.08^{fghij}	0.05
	Soya oil	Aluminium foil	2.57±0.52^{m}	0.37
		Ziploc	7.48±0.05^{abcde}	0.03
		Polypropylene	4.78±0.22^{jkl}	0.37
	Refined palm oil	Aluminium foil	6.58±0.48^{defgh}	0.34
		Ziploc	6.82±0.61^{cdefg}	0.43
		Polypropylene	5.72±0.08^{fghij}	0.05

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

Table 7: Effect of Days, Oil Type and Packaging on the Sensory Properties of Rabbit Meat Floss

			Sensory parameters					
Days	**Oil type**	**Packaging material**	**Aroma**	**Flavour**	**Taste**	**Juiciness**	**Roppiness**	**Acceptability**
7	Canola oil	Aluminium foil	4.73±2.22	5.73±1.87	6.87±1.60	5.40±1.68	5.87±1.92	7.27±1.49
		Ziploc	4.27±2.74	5.20±2.48	6.33±1.11	4.93±1.67	6.13±2.07	6.67±1.54
		Polypropylene	3.87±2.29	4.53±2.26	6.27±1.53	4.53±1.96	6.80±1.66	5.93±2.09
	Soya oil	Aluminium foil	4.60±2.23	5.80±1.93	6.60±1.30	4.73±1.87	5.73±2.12	6.87±1.36
		Ziploc	4.73±2.25	5.93±2.05	6.53±1.51	5.07±2.28	6.00±2.07	7.13±1.36
		Polypropylene	5.07±2.37	4.93±2.22	7.00±2.00	4.93±2.37	6.47±1.88	7.07±0.88
	Refined palm oil	Aluminium foil	4.33±2.19	5.27±2.22	6.60±1.68	5.00±2.04	5.80±1.97	6.67±1.88
		Ziploc	4.73±2.05	5.53±1.77	6.73±1.39	4.80±2.21	6.07±2.19	6.93±1.03
		Polypropylene	3.67±2.06	5.60±2.38	6.73±1.53	4.00±1.77	6.00±2.17	6.33±1.95
14	Canola oil	Aluminium foil	3.87±2.61	4.93±2.28	6.60±1.68	5.40±2.38	5.80±2.37	6.00±2.07
		Ziploc	3.80±2.57	5.40±1.92	6.40±1.35	5.20±2.34	5.27±2.15	6.07±1.79
		Polypropylene	4.20±2.51	4.40±2.20	6.33±1.29	4.80±2.43	5.33±2.53	6.33±1.45
	Soya oil	Aluminium foil	3.40±1.96	4.40±1.59	6.00±1.46	4.93±1.67	4.53±2.29	6.27±1.10
		Ziploc	3.80±1.97	4.27±1.83	6.47±1.13	4.80±1.74	5.40±2.23	6.20±1.21
		Polypropylene	3.93±1.94	4.27±1.28	5.80±1.15	4.53±1.51	6.07±2.43	6.07±1.03
	Refined palm oil	Aluminium foil	3.60±2.13	5.20±1.66	6.13±1.30	4.67±2.16	5.47±2.72	6.47±1.30
		Ziploc	3.47±1.64	4.20±1.52	6.13±0.99	4.47±1.88	5.40±2.03	6.07±1.10
		Polypropylene	2.87±1.60	4.53±1.55	5.33±1.23	4.07±1.98	5.07±2.05	5.33±1.40
21	Canola oil	Aluminium foil	5.27±1.91	5.67±1.63	6.67±1.59	5.33±1.72	4.93±2.84	6.67±1.54
		Ziploc	4.47±2.07	5.47±2.07	6.47±1.60	5.27±1.79	5.23±1.79	6.67±1.35
		Polypropylene	4.20±2.65	4.40±1.40	6.13±1.36	5.07±1.67	4.73±1.44	6.33±1.35
	Soya oil	Aluminium foil	4.60±1.72	4.87±1.92	6.73±1.44	5.67±1.68	5.07±2.37	6.53±1.25
		Ziploc	4.20±1.74	4.87±1.68	6.53±1.06	5.13±1.77	5.07±1.94	7.00±1.00
		Polypropylene	5.07±2.12	5.33±1.76	6.73±1.03	4.80±1.70	6.47±1.73	7.70±1.33
	Refined palm oil	Aluminium foil	4.20±2.65	4.40±1.40	6.13±1.36	5.07±1.67	4.73±1.44	6.33±1.35
		Ziploc	4.67±2.06	5.20±1.70	6.60±0.99	4.80±1.82	5.07±2.22	6.80±1.21
		Polypropylene	3.47±1.81	4.60±1.92	6.40v1.18	5.20±2.34	5.07±2.05	6.53±1.36

Means above are not significantly different (P>0.05)