ORIGINAL RESEARCH PAPER

PHYSICOCHEMICAL CHARACTERISTICS OF SNAIL AS AFFECTED BY PROCESSING METHODS, TEMPERATURES AND STORAGE DAYS

ABSTRACT

This study investigated the effect of processing methods, temperature and storage days on the physico-chemical characteristics of snail meat products. Four different treatments were carried out; unseasoned fried (USF), seasoned fried (SF), seasoned oven- dried (SOD) and seasoned smoke- dried (SSD) snail meat products and were stored under room, fridge and freezer storage conditions; physico-chemical determination and analysis of variance were carried out.. The results showed that the highest crude protein was obtained in the seasoned smoke-dried product (76.87%), followed by seasoned oven-dried product (75.80%), next was seasoned fried (70.15%) and the least was unseasoned fried product (68.57%). The highest ash value was seen in seasoned smoke-dried product (4.84%), followed by seasoned oven-dried (4.313%) and the least was unseasoned-fried product (3.933%). The highest energy values were observed in the fried products (1497.67kj/100g seasoned fried and 1490.53kj/100g unseasoned-fried).The highest iron value (16.47mg/100g) obtained was from seasoned smoke-dried product. Seasoned smoke-dried product was significantly different from other products and it had the highest mineral content. Seasoned oven-dried snail meat product had the lowest pH values 6.0, 7.17 and 6.29 for 0-5days 10-20days and 25- 30days storage respectively. This was followed by seasoned smoke-dried product having 6.68, 7.81 and 6.56 at 0-5days, 10-20days and 25-30days respectively. The observed low pH in seasoned products could be ascribed to the effect of the seasonings; this is an indication of better shelf stability it was observed that the combine effect of seasonings, smoke-drying and cold storage help to extend the shelf life of snail meat

Key words: Processing, temperature, snail, products. Seasoned

INTRODUCTION

The land snails, particularly the *A. marginata*, are alternative and non-conventional animal protein source in Nigeria and some other parts of Africa. Snails are processed by different methods for consumption. The different processing methods include roasting, oven-drying, frying etc. However, Onyeike and Oguike (2003) and Ojiato*et a*l., (2010) reported that different processing methods including boiling and roasting, influence the proximate, mineral and toxicant composition of foods. Preservation extends the shelf life of meat sample also it is regarded as any method of treatment of food material to prolong the length of time in which it retains its qualities and appearance (Ikeme, 1990). Preservation methods include freezing, thermal processing (dehydration e.g. oven drying and smoke drying) and curing method by using chemical additives (Ikeme, 1990).

Smoke-drying of meat is a technique in which meat is exposed directly to wood smoke which may be generated by a variety of methods. There are various substances in the smoke produced from wood which contribute to the flavour and the appearance of the smoke-dried meat product and which has certain preserving effect on the product (Asita and Campbell, 1990). The preserving effect of smoke is not very significant when storing the product without a cold chain. On the other hand, intensive or prolonged

smoke-drying may considerably increase the shelf-life of the product, but it also has an unfavourable effect on flavour. Whereas a light smoke generally enhances the organoleptic properties of the product, intensive smoking has a negative effect on the quality, especially in the case of prolonged storage in which concentrated smoke compounds develop increasingly unpleasant flavour (Asita and Campbell, 1990).

In modern meat processing industries, beef, pork, lamb, veal and calf carcasses are chilled in chill cooler at temperature ranging from -4 to 0^{o}C (Forrest *et al.*, 1975). Chilling storage is generally regarded to be storage at temperature not far above freezing. The refrigerated storage of meat and meat products at 5^{o}C -10^{o}C is generally limited to relatively short periods of time, since deteriorative changes continue to occur. The major factors that influence the storage life of meat under refrigeration include the initial microbial load, temperature and humidity conditions during storage, the presence or absence of protective coverings, the species of animal involved, and the type of product being stored (Forrest *et al.*, 1975). Freezing as a preservation method is not a new process. It has long been recognized as an excellent means of meat preservation. Meat is stored at temperature below or at -18^{o}C to prevent the growth of microbes as well as inhibiting enzymatic action. The most critical requirement includes light fitting and steady storage temperature of -18^{o}C or lower, (Ikeme, 1990).

The aim of this study was to investigate the effect of processing methods, temperature and storage days on the physico-chemical characteristics of snail meat products.

MATERIALS AND METHODS

Source of Snails:

The snails used for this experiment were collected from Ekiuwa market in Edo StateNigeria. A total of 150 adult snails (*Archachatinamarginata)* with mean live weight of 346.85g, were used. They were transferred to University of Benin where they were processed

Removal of Meat from Shells:

Snails were fasted for 24 hours in order to empty the gut and to reduce contamination during processing. Then the snails were weighed and separated into meat, shell, waste and fluid. The meats were washed with alum to remove the slime. Meats were cut to have uniform weight range of 50-55g.

Application of pickle in the preservation of fresh snail meat

Meat may be preserved by dry curing or with a pickling solution. The ingredients used in curing

and pickling are sodium nitrate, sodium nitrite, sodium chloride, sugar, citric acid or vinegar etc. Various methods are used: the meat may be mixed with dry ingredients; it may be soaked in pickling solution; pickling solution may be pumped or injected into the flesh; or a combination of these methods may be used.

In this study, snails were cured in a prepared pickle solution containing 1.5% salt, 1.5% sugar, 0.5% thyme, 0.30% nutmeg, 0.30% ginger, 1.50% red pepper, 0.05% sodium sorbate, 0.05% sodium tripolyphosphate, 0.50% curry, 1.50% onion for 24hours in refrigeration temperature, before processing snails (frying, smoke-drying and oven-drying). However, the control was devoid of spices before frying.

Table 1: Pickle Formulation

Ingredients	Percentage (%)	Weight (g)
Sugar	1.50	45
Salt	1.50	45
Thyme	0.50	15
Nutmeg	0.30	9
Ginger	0.30	9
Redpepper	1.50	45
Sodium sorbate	0.05	1.5
Sodium tri poly phosphate	0.05	1.5
Curry	0.5	15
Onion	1.50	45
Water	91.85	2755.5
Total	100%	3000g

Processing Methods:

Smoke–drying: - Pickle cured snail meat were skewed and smoke-dried at 80^{o}C for 2 hours 15 minutes in a smoking kiln at Kilishi factory, Ekenwan campus. Each snail meat was spread out with stick in a traditional bush meat processing manner to increase the surface area of the meat exposed to smoke and heat. The meat samples were spread on racks in the smoking kiln to ensure uniform smoking and drying of the individual product. Initial weights of snail meat prior to smoking were taken and weights after smoking were equally recorded.

Frying: - Pickle cured snails were fried at 170^{o}C for 30 minutes in a deep pan fryer with Soya oil (cholesterol free). 15 minutes into frying, meats were removed from oil, allowed to cool and weighed, allowed to cool and reweighed.

Oven-drying: Pickle cured snail meats were oven-dried at 90^{0}C for 4 hour 30 min using table electric

oven. The racks inside the oven were wrapped with foil paper before the meats were spread on them. At every 45 minutes interval, meats were removed, allowed to cool and weighed.

Packaging:

Snail meat products were allowed to cool before packaging all the products including seasoned smoke-dried product that was skewed before packaging. All products were sealed in low density cellophanes with the use of sealing machine.

Storage Temperatures:

In this experiment, three storage temperatures were used.

- Room temperature (28.5^{o}C)
- Refrigeration temperature (9.5^{o}C)
- Freezer temperature (-12.5^{o}C)

Storage Period:

Snail meat products were stored for total duration of 30 days and meat samples were withdrawn for analyses as follows.

- 0day (control)
- 5 days
- 10 days
- 15 days
- 20 days
- 25 days
- 30 days

Analytical methods:

Moisture content was determined by drying an accurately weighed sample of minced samples in an oven at 105 ±2ºC for 3 hours. The ash content was obtained by heating the sample for 3 hours at 550ºC (AOAC, 1990). Fat was extracted according to the acid hydrolysis method (AOAC, 1990). The total nitrogen content was determined by the Kjeldahl method and was converted to crude protein content by multiplying by 6.25 (AOAC, 1990). Crude fiber was determined by the method of the Association of Official Analytical Chemists (1990).

pH was determined on dispersion of two-gram sample in 10ml of distilled water while a pocket pH meter was used to take pH values.

Data Analysis:

Data generated were subjected to analysis of Variance (ANOVA) to test significant variations ($P<0.05$) among mean values obtained. Where significant differences existed, Duncan's multiple range test was applied to indicate where the differences occurred using Genstat statistical package 2005, 8TH

edition (Genstat Procedure Library Release PL16).

RESULTS AND DISCUSSION

Chemical Composition of Snail Meat Products

The result of this study showed that the crude protein, fat, moisture, ash, fiber and carbohydrate of a raw snail, were 16.69%, 4.87%, 64.03%, 3.78%, 3.47% and 6.89% respectively. The value of crude protein (16.69%) obtained is similar to the result (16.82%) of Okonkwo and Anyaene (2009). The moisture content (64.03%) obtained was similar to the result (63.1%) of Malik *et al*. (2011) but different from the work of Okonkwo and Anyaene (2009) who had 79.48%. The crude fiber (3.47%) obtained was not different from the result (3.45 %) reported by Omoyakhi and Osinowo (2010).

Analysis of variance showed significant difference ($P<0.001$`) in the chemical composition of the products based on treatment applied (Table 2). There was significant difference ($P<0.05$) in the crude protein content among the products. The highest crude protein was obtained in the seasoned smoke-dried product (76.87%), followed by oven-dried product (75.80%), next was seasoned fried (70.15%) and the least was unseasoned fried product (68.57%). The high protein value in seasoned smoke-dried product demonstrates that smoke component has preservative influence on crude protein due to reduction effect on pH by smoke components. Besides, wood smoke contains pyroligenous acid which may have added preservative effect on smoke-dried meat. Akhter*et al.* (2009) reported that protein value of smoked meat (77.92%) product was significantly ($P<0.05$) higher than crude protein of meat obtained from other processing methods. This could be attributed to lowering effect of pH by smoke components.

In terms of moisture content the different processing methods drastically reduced the moisture content of the raw snail meat. Pokomy (1999) reported that processing methods have the potential of removing moisture from samples. Chima and Akobundu (2010) reported that moisture content of sample decreases significantly ($P<0.05$) with processing. The seasoned oven-dried product with the lowest moisture content was significantly different ($P<0.05$) from other products. Smoke-dried product was significantly different ($P<0.05$) from other products in terms of ash content. The highest ash value was seen in seasoned smoke-dried product (4.84%), followed by seasoned oven-dried (4.313%) and the least was unseasoned-fried (3.933%) although, Adegbite *et al*. (2006) reported ash content of 4.23% for snail of 6-12 months old.

For fat content, seasoned-fried (4.920%) and unseasoned-fried (5.033%) snail products were significantly different ($P<0.05$) from smoke-dried (2.513%) and oven-dried products (2.57%). The high values recorded in the fried products could be attributed to oil absorption by the meat. Gil (1994) reported that lipid from frying oil could easily migrate into fried foods, increasing fat content.

There was significant difference (P<0.05) in carbohydrate content among all the products. The highest carbohydrate value was seen in unseasoned-fried product (8.16%) and the lowest was smoke-dried product (1.86%).

There was significant difference (P<0.05) among the products in terms of crude fiber. However, the unseasoned-fried product had the highest fiber (3.77%) content. The highest energy values were seen in the fried products (1497.67KJ/100g seasoned fried and 1490.53KJ/100g unseasoned-fried). Although, all the products energy values ranged from 1431.40 - 1497.67KJ/100g, these values are lower than the energy (1726 – 1740KJ/100g) reported by Engman *et al.* (2012) but greater than the values reported by Oduro*et al*. (2002) who reported 390.92 - 435.97KJ/100g. The energy values obtained in this study shows that snail meat could provide appreciable amount of calories in diet.

Table 2: Means for Chemical Composition of Snail Meat Products.

Parameter	Unseasoned Fried (311)	Seasoned fried (312)	Seasoned oven-dried (412)	Seasoned smoke-dried (512)	LSD

Protein(%)	68.567^{d}	70.150^{c}	75.803^{b}	76.867^{a}	0.1770
Moisture (%)	10.543^{a}	10.050^{b}	9.563^{c}	10.467^{a}	0.0773
Ash (%)	3.933^{d}	3.963^{c}	4.313^{b}	4.837^{a}	0.0129
Fat (%)	5.033^{a}	4.920^{a}	2.570^{b}	2.513^{b}	0.1227
Crude fibre (%)	3.767^{a}	3.677^{b}	3.490^{c}	3.453^{d}	0.0179
Carbohydrate(%)	8.157^{a}	7.240^{b}	4.260^{c}	1.863^{d}	0.2681
Energy(KJ/100g)	1490.53^{b}	1497.67^{a}	1456.17^{c}	1431.40^{d}	2.813
Ca (mg/100g)	146.3^{c}	153.7^{bc}	156.7^{b}	165.7^{a}	8.22
Fe(mg/100g)	14.07^{d}	14.70^{c}	15.20^{b}	16.47^{a}	0.38
P (mg/100g)	183.0^{d}	196.3^{c}	204.7^{b}	235.0^{a}	7.33
Cu (mg/100g)	74.63^{d}	87.0^{c}	96.67^{b}	104.23^{a}	4.05
K (mg/100g)	305^{d}	327.3^{c}	358^{b}	386.3^{a}	10.98
Mg (mg/100)	57.63^{c}	60.55^{b}	62.97^{a}	64.63^{a}	2.29

Means with same superscript along the row are not significantly differently (P>0.05).

The results of this work showed that raw snail has Calcium (124.32mg/100g), iron (2.27 mg/100g), Phosphorus (21.97mg /100g), Magnesium (23.95mg/100g), Copper (1.08mg/100g) and potassium (26.7mg /100g) contents. The values obtained are not different from the result of Malik *et al.* (2011) who reported Ca (126mg/100g), Fe (2.29mg/100g), P (22.9mg/100g), Mg (25.1mg/100g) and Cu (1.03mg/100g). Adeola*et al*. (2010) reported Calcium (187mg/100g) and potassium (25.6mg/100g) for raw snail. The minerals for processed snail ranges from 146.3mg/100g - 165.7mg/100g for calcium, iron ranges from 14.07 - 16.47mg/100g, phosphorus ranges from 183.0 - 235.0mg/100g, copper ranges from 74.63-104.23mg/100g, potassium ranges from 305 - 386.3mg/100g and magnesium ranges from 57.63-64.63mg/100g.

From the analysis of variance the seasoned smoke-dried product was significantly different (P<0.05) from other products and had the highest mineral content. The value obtained for P (235mg/100g) was different from the value obtained (61.24mg/100g) by Imevbore and Ademosun (1988).

However, a higher value of 272mg/100g was reported by www.weightlossforgood.co.uk (2003). Phosphorus and potassium are important in human and animal nutrition. Phosphorus is used for normal development and maintenance of bones and teeth, cell activity, normal acid-base balance of blood, muscle activity, metabolism of carbohydrate and fat (Ihekoronye and Ngoddy, 1995).

The highest iron value obtained (16.47mg/100g) was from seasoned smoke-dried product. This is close to the result obtained by Wosu, 2003 (12.2mg/100g). However, the value obtained was different from 1.4-3.5mg/100g reported by Imevbore and Admosun (1988). Wosu (2003) reported that iron content of snail varies from one locality to another depending on mineral content of the soil in which these snails are raised. Iron is good for bone and teeth formation as well as for haemoglobin of the red blood cells. Cobalt (Co) was not detected. According to Fugbuaro*et al.* (2006) the non–detection of lead and cobalt confirm that none of the snail had been exposed to any sort of pollution.

pH changes of snail meat products

The analysis of variance showed that there was significant difference ($P<0.001$) in the main and interactive effects in pH values of the different snail meat products based on treatments (Processing methods, storage conditions and storage days).

The average pH value of raw snail washed without alum was 7.02 while raw snail washed with alum had an ultimate pH of 7.3. This value agreed closely with the work of Okonkwo and Anyaene (2009) who reported pH value of 7.4, this according to them is due to the basicity of potassium alum used for washing the foot, which tends to raised pH value.

Table 3 showed the main effect of processing methods on the pH of products. There was significant difference ($P<0.05$) in the different products stored for 0-5days, 10-20days and 25-30days, respectively. Seasoned oven-dried snail meat product (412) had the lowest pH values 6.0, 7.17 and 6.29 for 0-5days 10-20days and 25- 30days storage respectively. This was followed by seasoned smoke-dried product having 6.68, 7.81 and 6.56 respectively. Moreover, it was observed that seasoned products had lower pH than the unseasoned product, an indication of better shelf stability of the seasoned products. This could be attributed to the presence of salt and other curing ingredients which altered the pH of the seasoned products, thereby limiting the growth of spoilage organisms. According to Dzudie and Okubanjo (1992) salt increases pH values but the result of this study showed that the interactive effect of salt and other spices inclusion in the seasoned snail meat products lowered the pH thereby ensuring shelf stable products.

Table 4 showed the effect of storage conditions on pH of products. There was significant difference ($P<0.05$) between products under room storage (7.20) and products under cold storage (fridge 6.61 and freezer 6.05) at 5 days. Products under room and fridge storage could not last beyond 5 days and

20 days respectively. Table 5 also showed significant difference ($P<0.05$) in the pH of products stored for 10days (7.51), 15days (8.22) and 20days (8.59).

Table 6 showed the pH values of the interaction between processing methods and storage periods. The pH values of the snail meat products significantly ($P<0.05$) increased with the storage days (0-5 and 10-20) but with insignificant ($P>0.05$) decline at 25days. Seasoned oven-dried product had the lowest pH values of 5.76, 6.69 and 6.26 for 0-5days, 10-20days and 25-30days storage period respectively. This was followed by seasoned smoke-dried product (6.40, 7.54 and 6.49). The unseasoned-fried product (control) had the highest pH values at 5days (7.98), 20days (9.77) and 25days (8.33) storage. This high value was responsible for the short shelf life of the unseasoned fried product (control). Kiers *et al.* (2000) reported that the increase in pH value during storage is due to the degradation of protein.

Table 7 showed the changes in pH values of products due to the interaction between storage conditions and storage days. There was significant difference ($P<0.05$) between pH of products stored for 0-5days, 10-20days and 25-30days under the different storage conditions. Products under room storage increased significantly ($P< 0.05$) in pH than snail meat products under cold storage from 0-5days. Also, products under fridge (6.70) storage condition were not significantly ($P>0.05$) different from snail meat under freezer (6.65) storage at 5days. This implies that cold storage helps to control and stabilize pH of meat products thereby enhancing their shelf stability. Ikeme (1990) reported that refrigeration extends shelf stability and prevent product deterioration. A significant increase ($P<0.05$) was observed in the pH values of products under refrigerated storage from 10-20days. This result is similar to that of Webster *et al.* (1982) who reported that increased pH of smoked meat during refrigerated storage might be due to hydrolysis of the collagen fibers which released amino group in meat system.

The interaction between processing methods and storage conditions is shown in Table 8. At 0-5 days' storage, the pH of the various products at refrigeration condition was lower than products under room storage but higher than products under freezer storage. The snail meat product is better shelf stable under fridge and freezer storage due to lower pH as product in refrigeration storage had shelf life of 20days, freezer storage could last 30 days and beyond while room stored products lasted for 6days. This was also reflected in Table 9.

Table 3: pH Means of Snail Meat Products (Processing methods).

Storage Days	Treatments (Processing methods)				
	Unseasoned/ fried	Seasoned/ fried	Seasoned/ oven-dried	Seasoned/ smoke-dried	LSD
0 – 5	7.711[a]	6.811[a]	6.000[d]	6.689[c]	0.0839
10 – 20	9.147[a]	8.046[b]	7.170[d]	7.817[c]	0.1317
25 – 30	8.226[a]	6.708[b]	6.290[d]	6.563[c]	0.0207

Means within storage day bracket having same superscript are not significantly different (P>0.05)

Table 4: pH Means of Snail Meat Products (Storage conditions)

Storage days	Treatments(Storage conditions)			
	Room (28.5^0C)	Fridge (9.5^0C)	Freezer (-12.5^0C)	LSD
0 – 5	7.207[a]	6.617[b]	6.058[b]	0.0727
10 –20	-	9.129	6.961	0.0927
25 – 30	-	-	-	-

Means within storage day bracket having same superscript are not significantly different (P>0.05).

Table 5: pH Means of Snail Meat Products (Storage days)**.**

Storage days	Means values	LSD
0	6.525	
		0.0593
5	7.081	
10	7.518[c]	
15	8.220[b]	0.1141
20	8.595[a]	
25	7.022	0.014
30	6.871	

Means with the same letters are not significantly different (P>0.05).

Table 6: Effect of storage on pH changes of snail meat

	Storage period (days)						
Products	0	5	10	15	20	25	30
311	7.433^{b}	7.989^{a}	8.278^{d}	9.385^{b}	9.778^{a}	8.333^{a}	8.120^{b}
312	6.500^{e}	7.122^{c}	7.557^{gh}	7.945^{ef}	8.635^{c}	6.813^{c}	6.603^{d}
412	5.767^{g}	6.233^{f}	6.697^{j}	6.977^{i}	7.837^{f}	6.313^{f}	6.266^{g}
512	6.400^{e}	6.978^{d}	7.540^{h}	7.782^{fg}	8.130^{de}	6.630^{d}	6.496^{e}
Sem	0.0417			0.0801		0.0096	

Means within storage day bracket having same superscript along the row and down the column are not significantly different (P>0.05).
311= unseasoned fried
312=seasoned fried
412=seasoned oven-dried
512=seasoned smoke-dried

Table 7: pH Means of Snail Meat Products (storage conditions and storage days)

	Storage period (days)						
Storage Condition	0	5	10	15	20	25	30
Room (28.5^{o}C)	6.525^{c}	7.883^{a}	-	-	-	-	-
Fridge (9.5^{o}C)	6.525^{c}	6.708^{b}	8.285^{c}	9.168^{b}	9.932^{a}	-	-
Freezer (-12.5^{o}C)	6.525^{c}	6.650^{b}	6.751^{e}	6.876^{e}	7.257^{d}	7.022	6.8717
Sem	0.0361			0.0567		0.0048	

Means within storage day bracket having same superscript along the row and down the

column are not significantly different (P>0.05).

Table 8: pH Means of Snail Meat Products (Processing methods and storage conditions)

Products	Fridge (9.5^{o}C)	Freezer (-12.5^{o}C)	Room (28.5^{o}C)
0-5days			
311	7.517^{b}	7.483^{bc}	8.133^{a}
312	6.533^{e}	6.550^{e}	7.350^{c}
412	5.817^{h}	5.817^{h}	6.183^{f}
512	6.417^{e}	6.500^{e}	7.150^{d}
Sem	0.0511	0.0511	0.511
10-20days			
311	10.208^{a}	8.087^{d}	-
312	9.267^{b}	6.824^{e}	-
412	8.162^{d}	6.178^{f}	-
512	8.878^{c}	6.757^{e}	-
Sem	0.0654	0.0654	
25-30days			
311	-	8.227^{a}	-
312	-	6.708^{b}	-
412	-	6.290^{d}	-
512	-	6.563^{c}	-
Sem	0.0068		

Means within storage day bracket having same superscript along the row and down the column are not significantly different (P>0.05).
311= unseasoned fried
312=seasoned fried
412=seasoned oven-dried
512=seasoned smoke-dried

Table 9: pH Means of Snail Meat Products (Processing methods, storage days and storage conditions).

Products	Storage conditions	Storage period(days) 0	5	10	15	20	25	30
311	Freezer(-12.5^{0}C)	7.433^{d}	7.533^{d}	7.703^{gh}	7.903^{g}	8.653^{ef}	8.333^{a}	8.120^{b}
312	Freezer(-12.5^{0}C)	6.500^{e}	6.600^{e}	6.670^{i}	6.867^{i}	6.937^{i}	6.813^{c}	6.603^{d}
412	Freezer(-12.5^{0}C)	5.767^{g}	5.867^{g}	5.933^{j}	6.027^{j}	6.573^{i}	6.313^{f}	6.266^{g}
512	Freezer(-12.5^{0}C)	6.400^{ef}	6.600^{e}	6.697^{i}	6.707^{i}	6.867^{i}	6.630^{d}	6.496^{e}
311	Fridge(9.5^{0}C)	7.433^{d}	7.600^{d}	8.853^{de}	10.867^{a}	10.903^{a}	-	-
312	Fridge(9.5^{0}C)	6.500^{e}	6.567^{e}	8.443^{f}	9.023^{d}	10.333^{b}	-	-
412	Fridge(9.5^{0}C0)	5.767^{g}	6.233^{f}	7.460^{h}	7.927^{g}	9.100^{cd}	-	-
512	Fridge(9.5^{0}C)	6.400^{ef}	6.433^{ef}	8.383^{f}	8.857^{de}	9.393^{c}	-	-
311	Room(28.5^{0}C)	7.433^{d}	8.833^{a}	-	-	-	-	-
312	Room(28.5^{0}C)	6.500^{e}	8.200^{b}	-	-	-	-	-
412	Room(28.5^{0}C)	5.767^{g}	6.600^{e}	-	-	-	-	-
512	Room(28.5^{0}C)	6.400^{ef}	7.900^{c}	-	-	-	-	-
Sem		0.0722			0.1133		0.0096	

Means within storage day bracket having same superscript along the row and down the column are not significantly different (P>0.05).

311= unseasoned fried

312=seasoned fried

412=seasoned oven-dried

512=seasoned smoke-dried

CONCLUSION

The various processing methods caused reduction in the moisture content of products particularly oven-drying. The high protein value in seasoned smoke-dried product demonstrated that smoke component has preservative influence because of the polyphenols which has antimicrobial properties. All the seasoned products had low pH values than the unseasoned product and this could be ascribed to the effect of the seasonings. The pH of the product under refrigeration condition was lower than product under room storage but higher than product under freezer storage. For extended shelf life and increase in nutritive component of snail meat there should be a combined effect of seasonings, smoke-drying and cold storage.

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