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## Investigation of different factors affecting to the buffalo sausage shelf-life

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### Abstract

On the market, we normally see sausage made from pork meat or seafood. On the purpose of diversification for sausage products, we primarily investigate various factors influencing to the buffalo sausage shelf-life. Some comments are finalized as mixture 70% lean buffalo meat: 30% pork fat; 3% salt; 12% sugar. Drying time 12 hours in 60°C is needed to reduce moisture content to 25% so that it can maintain color, flavour and firmness of characterized sausage. This sausage can be preserved in 27 days in normal sealing bag and 60 days in vacuuming bags.

**Keywords:** drying, color, flavour, firmness, shelf-life, buffalo sausage

### 1. Introduction

Buffaloes are of two types, riverine buffalo (*Bubalus bubalis*) and swamp buffalo (*B. bubalis*). Buffalo meat is the healthiest meat among red meats known for human consumption since it is low in calories and cholesterol. Buffalo meat is well comparable to beef in many of the physicochemical, nutritional, functional properties and palatability attributes. Meat from buffalo is called by various terminologies in different countries according to the age of slaughter. Buffaloes have a unique ability to utilise coarse feeds, straws and crop residues converting them into protein rich lean meat. The carcass composition varies with dressing percentage of buffalo carcasses. The dark buffalo meat possesses good binding properties and is preferred in product manufacture (G. Kandeepan *et al.*, 2009).

Buffaloes, which have a lower muscle pH than cattle, displayed a significantly smaller amount of collagen in the muscles studied, but the species did not differ significantly in the degree of intramuscular collagen crosslinking (C. Valin A. Pinkas *et al.*, 1984). Buffalo meat has gained importance in the recent years because of its domestic needs and export potential. Buffalo meat is well comparable to beef in many of the physicochemical, nutritional, functional properties and palatability attributes (Anjaneyulu *et al.*, 1990).

Buffalo meat produced in Vietnam is largely consumed in local market. Conversion of buffalo meat into a value-added product such as sausage would further enhance the foreign exchange earnings. Buffalo meat being comparatively cheaper will have additional advantages over other meats. Sausage is a popular and highly relished meat product world over. There are several studies mentioned to buffalo sausage manufacture (N.M. Sachindra *et al.*, 2005; R. Ponsingh *et al.*, 2010; S. Sureshkumar *et al.*, 2010; Javier F. Rey *et al.*, 2011; S Ahmad *et al.*, 2012). Our study aims at investigation about some factors influencing to buffalo sausage shelf-life.

### 2. Material & Method

#### 2.1 Material

Lean buffalo meat, pork fat, artificial intestine, sugar, salt, pepper, alcohol, sodium nitrite and sodium ascorbate are used for experiments. The research is performed in Tra Vinh province, Vietnam.

#### 2.2 Research method

All experiments are designed at mixing, drying and preserving stages. Each experiment is replicated three times and statistically analysed by MINITAB software.

##### 2.2.1 Compositions in buffalo meat

Choose raw buffalo meat with 50 gram per sample to analyse some parameters. Three replications are needed to get the average value. Determination of buffalo meat compositions is based on some testing methods below:

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- Moisture content: by drying to basic weight (105 °C)
- Protein: by Kjeldahl method
- Lipid: by Soxhlet method
- pH of buffalo meat juice: by pH meter

**2.2.2 Experiment #1: Effect of mixture (lean meat: fat) to sausage firmness**

Process sausage by changing mixture ratio (lean meat/fat): 80%:20%, 70%:30%, 60%:40%. Sensory evaluation is based on its firmness and preference.

**2.2.3 Experiment #2: Effect of salt and sugar content to sausage taste**

Sugar supplementation (%): D (D1=8; D2=10; D3=12)  
 Salt supplementation (%): N (N1 = 2.5; N2 = 3.0; N3 = 3.5)  
 Sensory evaluation is based on taste and preference.

**2.2.4 Experiment #3: Effect of sun drying- drying to sensory and preservation time**

Sausage is prepared and then treated to drying or sun drying experiments. Drying: take sample to analyse moisture in every 30 minutes. Sun drying: take sample to analyse moisture in every hour. We monitor color, flavour and appearance to find out the appropriated treatment. Sausage products are then evaluated peroxide, NH3, microorganism to see the difference between drying and sun drying.

**2.2.5 Experiment #4: Effect of packing method to preservation capability**

Samples are arranged in bag or cluster in clean dry cool place to evaluate preservation time. Color, flavour and appearance are monitored in sausage products. These samples are also analysed peroxide and microorganism during the preservation time.

**3. Result & Discussion**

**3.1 Compositions in raw buffalo meat**

Buffalo meat has nutritious elements (see table 1).

**Table 1:** Compositions in raw buffalo meat

Composition	Amount
Moisture	70.26%
Total protein	19.61%
Total lipid	6.20%
Ph	5.62-5.84



**Fig 2:** Raw buffalo, fat pork and artificial intestine

Because buffalo meat has high moisture content, protein and lipid, it's very difficult to preserve. In sausage manufacture, we apply many strategies to preserve meat. Meat is minced and stuffed into artificial intestine to prevent deterioration. Drying or sun drying is used to decrease free moisture, combined with salt, sugar and additive together with appropriated packing to prolong shelf-life.

**3.2 Effect of buffalo: fat pork to product firmness**

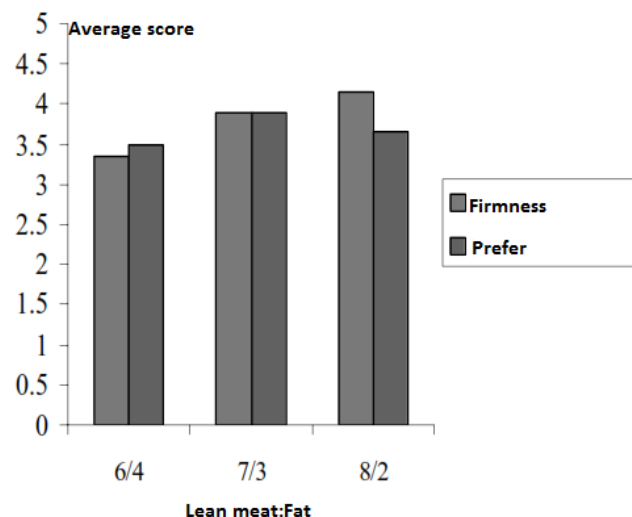
Fat plays important role in product characteristics. Apart from smooth structure, fat contributes not only to good flavour and fatty feeling but also emulsification. Fat addition also reduces water activity so that product shelf-life is extended. However, if there is too much fat, it will decrease sensory characteristics. Our experiments are executed in three different mixture ratios. Results are depicted in table 2.

**Table 2:** Sensory evaluation for samples by different mixtures

Lean meat: fat	Parameters	
	Firmness	Preference
60%:40%	3.35 <sup>a</sup>	3.50 <sup>a</sup>
70%:30%	3.90 <sup>ab</sup>	3.90 <sup>a</sup>
80%:20%	4.15 <sup>b</sup>	3.65 <sup>a</sup>
	F=4.67	F=1.32
	P=0.013	P=0.267



**Fig 3:** Minced buffalo meat and fat pork



**Fig 4:** Sensory score at different mixtures

Looking into figure 4 and table 2, samples with 60% lean buffalo meat are not highly valued. Samples with 70% lean buffalo meat are highly valued both firmness and preference. Samples with 80% show good firmness but low preference. So we choose mixture 70% lean buffalo meat: 30% pork fat for further researches.

**3.3 Effect of salt and sugar supplementation to product taste**

Salt plays vital role in food preservation and taste adjustment. Combination of salt and sugar will create pleasant feeling.

**Table 3:** Sensory evaluation for products supplemented salt and sugar

Sample	Parameter	
	Flavor	Preference
2.5%-8%	3.550 <sup>a</sup>	3.150 <sup>a</sup>
2.5%-10%	3.400 <sup>a</sup>	3.150 <sup>a</sup>
2.5%-12%	3.850 <sup>ab</sup>	3.550 <sup>a</sup>
3.0%-8%	3.650 <sup>a</sup>	3.450 <sup>a</sup>
3.0%-10%	3.800 <sup>a</sup>	3.700 <sup>a</sup>
3.0%-12%	4.650 <sup>b</sup>	4.600 <sup>b</sup>
3.5%-8%	3.750 <sup>a</sup>	3.350 <sup>a</sup>
3.5%-10%	3.600 <sup>a</sup>	3.400 <sup>a</sup>
3.5%-12%	4.050 <sup>ab</sup>	3.950 <sup>ab</sup>
	F=3.76	F=4.88
	P=0.000	P=0.000

In table 3, almost samples are fairly valued about taste with minor difference. Samples having high sugar content (12%) always highly evaluated because it creates good flavour and aroma.



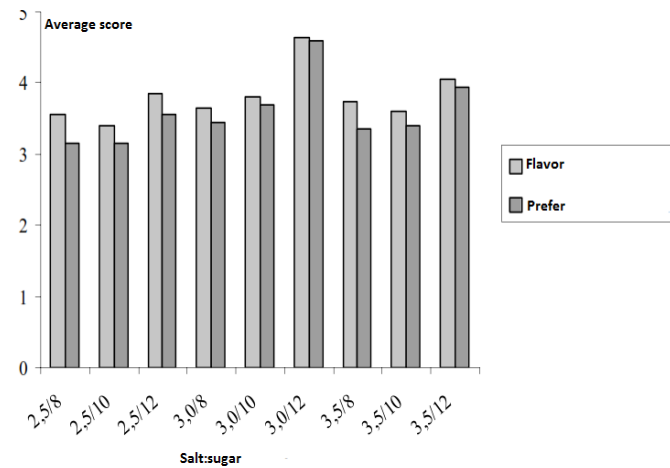
**Figure 5:** Stuffing minced buffalo meat and fat pork into artificial intestine

Salt content in sausage is analysed with results as in table 4 below.

**Table 4:** Salt content in sausage

Sample	Salt %
	Finished product
2.5	2.83
3.0	3.88
3.5	4.36

Samples treated with 2.5% salt after drying/ sun drying, the salt concentration in sample will be 2.83%. This content is quite low and not enough for sour prevention out of microorganism. For samples treated with 3.0% salt, after drying/ sun drying, the salt concentration in sample will be 3.88% which is enough for microbial prevention. Samples treated with salt 3.5% give bad taste and hard structure.



**Fig 6:** Sensory score for products supplemented different sugar contents

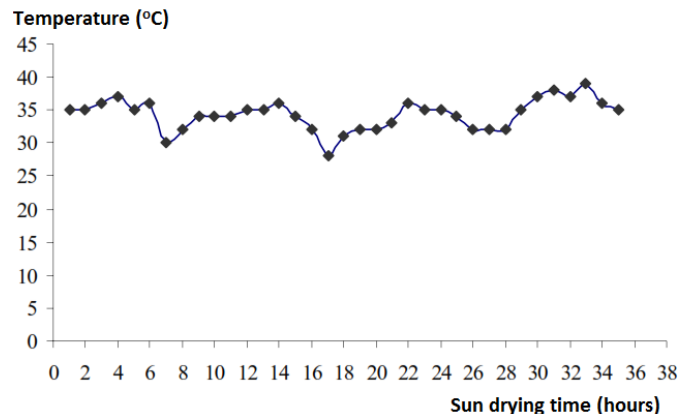
Though figure 6, sample #6 (3.00% salt, 12% sugar) is superior in respect of flavour and preference. This parameter is chosen for next researches.

**3.4 Effect of drying or sun drying to sausage quality**

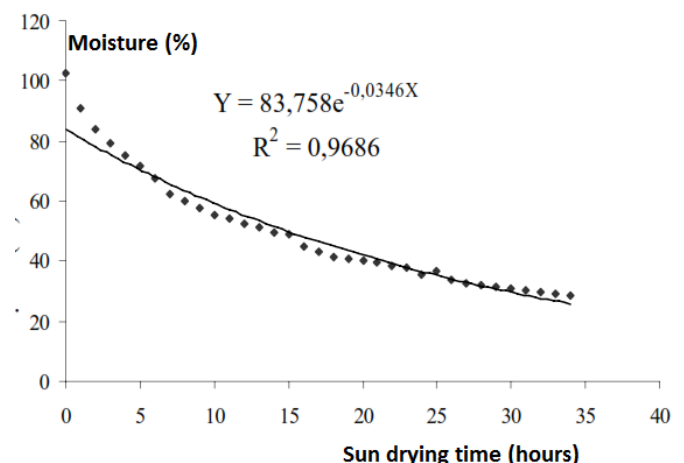
Moisture reduction is a vital method to prolong product shelf-life. Drying can be considered as an able approach.

**3.4.1 Sun drying**

Sun drying treatment is not superior to drying owing various aspects, including temperature fluctuation at different intervals during the day.



**Fig 7:** Temperature fluctuation during sun drying



**Fig 8:** Moisture fluctuation during sun drying

Temperature of sun drying is quite low (30- 40 °C) and unstable so the sun drying time is always long and bad product quality. Moreover, sunlight also destroys some pigments to dark colors.



Fig 9: Sausage before sun drying



Fig 10: Sausage after sun drying

### 3.4.2 Drying

Drying creates good product quality at 55 - 65 °C which is superior and more stable to sun drying. We investigate three drying temperature regimes.

#### 3.4.2.1 Drying at 55 °C

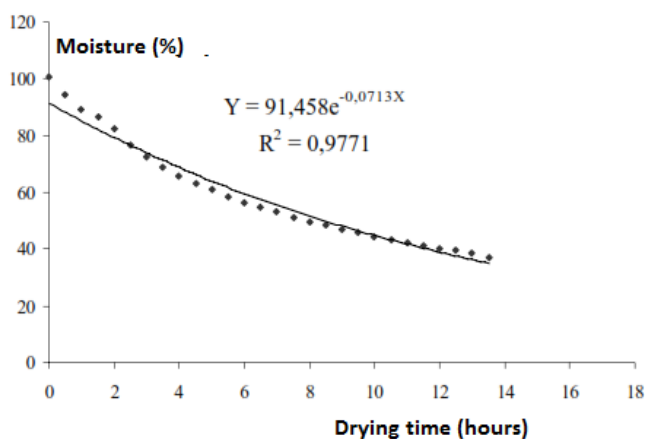


Fig 11: Moisture change by drying time at 55 °C

At 55 °C, drying time needed to get 25% moisture content is 13.5 hours.

#### 3.4.2.2 Drying at 60 °C

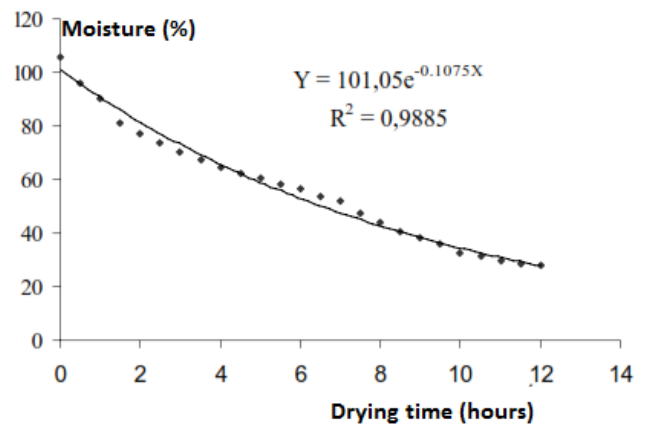


Fig 12: Moisture change by drying time at 60 °C

At 60 °C, drying time needed to get 25% moisture content is 12 hours.

#### 3.4.2.3 Drying at 65 °C

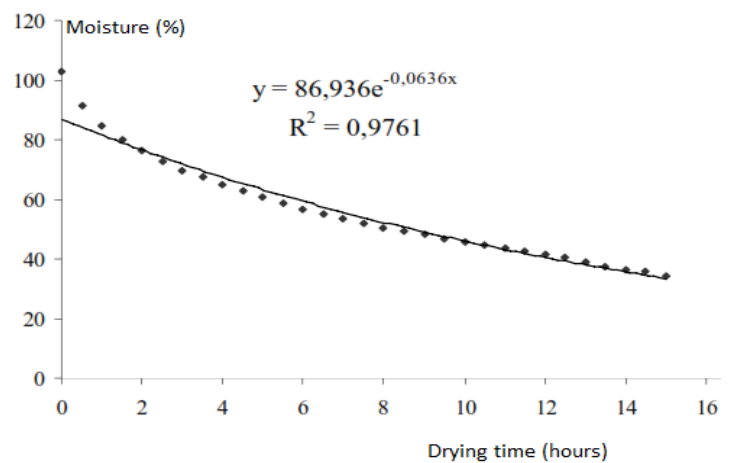


Fig 13: Moisture change by drying time at 65 °C

At 65 °C, drying time needed to get 25% moisture content is 15 hours. This phenomenon is explained by hard surface on sausage which hinders evaporation by drying at high temperature. Drying temperature at 60 °C is suitable for sausage manufacture.

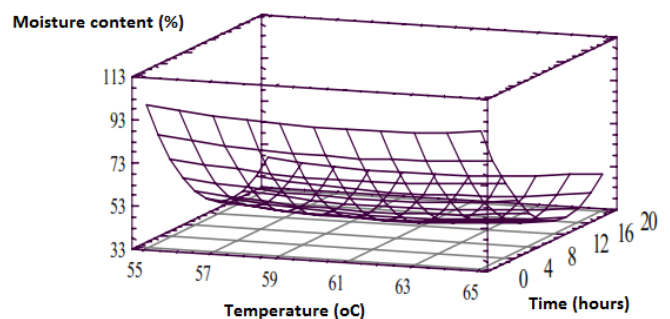


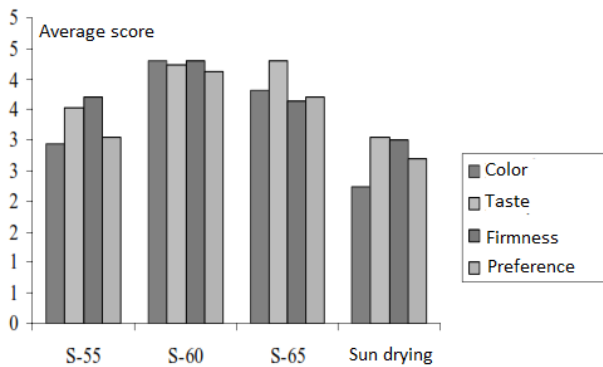
Fig 14: Correlation between moisture and drying time

Correlation among moisture, temperature and drying time is depicted in figure 14.

**Table 5:** Sensory evaluation for products during sun drying and drying

Sample	Parameter			
	Color	Flavor	Firmness	Preference
Drying 55 °C	2.941a	3.529a	3.706a	3.059a
Drying 60 °C	4.294b	4.235ab	4.294b	4.118b
Drying 65 °C	3.824b	4.294ab	3.647a	3.706b
Sun drying	2.235c	3.059c	3.000c	2.706a
	F=41.58	F=13.77	F=11.31	F=18.42
	P=0.000	P=0.000	P=0.000	P=0.000

Drying at 55 °C shows good appearance but too long. Drying at 60 °C is adequate to get good color, flavour and aroma. Firmness and smoothness are noticed at this regime. Drying at 65 °C gives good color, flavour and aroma with exception of coarsed structure by low moisture content on surface and high moisture inside.



**Fig 15:** Difference of sensory values in drying and sun drying

In figure 15, drying at 60 °C contributes to good sausage quality including color, flavour, aroma and preference. So this temperature is selected for sausage production.



**Fig 16:** Sausage before drying



**Fig 17:** Sausage after drying

**3.5 Effect of packing method to product shelf-life**

Sausage has high moisture content 25% so it's difficult for preservation with deteriorations: sour, mold, lipid oxidation. Vacuum packing is an effective action to remove oxygen out of oxidation.

**Table 6:** TPC formation during fermentation

Preservation time (days)	TPC (cfu/g)			
	Control sun drying	Sun drying for vaccum packing	Control drying	Dry vaccum packing
0	1.2.10 <sup>4</sup>	1.2.10 <sup>4</sup>	4.1.10 <sup>3</sup>	4.1.10 <sup>3</sup>
7	8.6.10 <sup>4</sup>	1.5.10 <sup>4</sup>	6.1.10 <sup>4</sup>	4.6.10 <sup>3</sup>
14	1.5.10 <sup>5</sup>	1.8.10 <sup>4</sup>	8.4.10 <sup>4</sup>	5.2.10 <sup>3</sup>

**Table 7:** NH3 formation during preservation

Preservation time (days)	NH3 (mg/100g)			
	Control sun drying	Sun drying for vaccum packing	Control drying	Dry vaccum packing
0	3.82a	3.82a	2.44a	2.44a
7	15.25b	6.53a	5.67a	2.98a
14	22.41b	7.12a	13.08b	4.02a
	F=50.41	F=4.80	F=62.26	F=2.54
	P=0.005	P=0.116	P=0.004	P=0.226

**Table 8:** Peroxide accumulation during preservation

Preservation time (days)	Peroxide (mg/100g)			
	Control sun drying	Sun drying for vaccum packing	Control drying	Dry vaccum packing
0	0.83a	0.83a	0.58a	0.58a
7	1.15a	0.94a	0.73ab	0.66a
14	2.67b	1.23b	1.26b	0.80a
	F=26.84	F=31.90	F=5.56	F=1.20
	P=0.012	P=0.010	P=0.098	P=0.414



**Fig 18:** Bare preservation



**Fig 19:** Vacuum packed preservation

### 3.6 Nutrient composition in buffalo sausage

**Table 9:** Nutrient composition in buffalo sausage

Parameter	Percentage (%)
Moisture	25.52
Protein	25.24
Lipid	32.45
Salt	3.86
NH <sub>3</sub>	2.56
TPC	4.3x10 <sup>3</sup> (cfu/g)



**Fig 20:** Buffalo sausage

#### 4. Conclusion

The potentialities of buffaloes as food animals to meet present and future demands of rapidly growing population deserve special attention. Studies are conducted on development, quality evaluation and shelf life of buffalo meat sausage. Buffalo meat can be utilized for development of the sausage. The buffalo sausage is self-stable product and it can be very well preserved under dried- vacuum packing.

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