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Production of Ready to Eat Sausage by New Method

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ABSTRACT

Sausage is considered an attractive meal for all people especially youth and children. Sausage should be cooked before eating. In this paper. The aim of this study is to produce dry sausage good for all purpose especially going outs and tours without the need to keep it under cooling or freezing condition and it is considered safe from the microbiological point of view. According to the taste panel carried out, the 12 hour drying time sample was better than the 14 hours sample, in color, taste, consistency, overall acceptability and juiciness. The 12 hour sample has 37.88% moisture, 40.70% protein, 13.86 fat, 3.09% ash, 4.47% carbohydrates. Also has a moisture protein ratio (MPR) (0.95:1) and lost 35.6% of the fresh moisture although it has 37.88% moisture, it's water activity (a_w) is 0.81 which means it is microbiologically safe.

Key words: Dry sausage, dry cooked sausage, ready to eat sausage

Introduction

Beef sausage is one of the most traditional meat products in Egypt and it's mostly produced from beef meat, fat tissues, dry rusk, salt and spices.

Fermented sausage can be either dry or semidry. The most well-known dry sausage, such as Genoa salami, dry salami, and pepperoni, originated from Italy (Ricke and Keeton, 1997). In general, dry sausage have a final pH of 5.0-5.3, lactic acid percent of 0.5-1.0% and an MPR of 2.3:1. The moisture loss is between 25-50% and the final moisture percent on average is 35% with water activity (a_w) ranging between 0.85 to 0.091.

The moisture content for these products ranged from 25-39%.All of these products, because of their moisture to protein ratios, are considered shelf stable (Fsis, 1986; Rick and Keeton, 1997).

Dry sausage are dried at a lower temperature between 10-11.2ºC and a slightly higher relative humidity of 68-72%, and the drying period lasts for 21 days or more (Bacus, 1986; Lucke, 1985) in the united states department of agriculture (USDA), food safety and inspection service. Food safety information bulletin (2011), it was stated that dry sausages require more time to make than other types of sausages and are a more concentrated form of meat, and it can kept for 6 weeks without the need refrigerator. Dried sausage range from 60% to 80% of their original weight before drying. Some dry sausages are shelf stable (in other word, they don't need to be refrigerated or frozen to be stored safety). Dry sausages require more production time than other types of sausages and result in a concentrated form of meat. If the product is shelf stable and ready to eat, the product will not require to have a safe handling statement cooking directions or a "keep refrigerated" statement. All sausages except dry sausage is perishable and therefore must be kept refrigerated.

Biltong production uses a method of air-drying there lean beef at 39ºC. effectively, this beef hasn't been subjected to oven cooking, the protein hasn't denatured and also vitamins and other functional compounds have not degraded at this temperature. Due to the decreasing water content (denoted a_w), the pH environment inside and on the surface of the meat decreases to and below 5.5 this makes the environment inhabitable for food pathogens such as *Ecoli 0157:H7*, *Salmonella sp.* and also Listeria monocytes making the Biltong safe for human consumption (Heniz and Hautzinger 2007).

The university of Wisconsin-Madison, center for meat process validation has conducted number of studies; (Ingham *et al.,* 2006 and Burnham *et al.,* 2008), concerning the fermentation and drying of certain meat products. The studies conclusively proved the food safety of low temperature prepared Biltong products. In an investigation by Burnham *et al.,* 2008, they prepared Biltong at 22ºC, 50% relative humidity for a period ranging from 17-26 days for Biltong until the meat reached a_w of 0.6 and pH 5.5. Burnham *et al.,* (2008) used acid-adapted pathogens. The same study also showed that preparing Biltong at temperatures of 22ºC is more than safe for human.

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Materials and Methods

Materials:

Imported frozen beef meat (Brazilian product) and fat tissues (sheep tail) were purchased from a private sector shop in the local market at Giza, Egypt. Other ingredients used in sausage preparation such as spice mixture, sodium chloride and soy protein or starch, garlic and black pepper were also purchased from local market at Giza, Egypt.

Methods:

Preparation of beef sausage samples and formula:

Beef sausages were processed according to the following formula:- frozen beef (65%), sheep fat tail (15.0%), starch (5.0%), garlic (2.5%), sodium chloride (2.5%), spice mixture (15g): [2g black pepper+3g cubeb+1g Nutmeg+2g Fennel+2g cinnamon+2g cardamom+2g cumin+1g clovers], sugar (1.0%), yoghurt + ropy milk (1:1 by weight) (5.0%), soya sauce (2.0%) and sodium glutamate (0.5%).

Frozen beef meat was cut into approximately 5cm cubes. Beef meat and sheep fat tail were minced twice. The other ingredients were added and mixed together. The mixture was ground for a third time using a laboratory mixer (Hobbart kneading machine) for 10 minutes. The obtained emulsion was stuffed into a nature casings which were hand linked at about 15 cm intervals. Then all sausages were dried in a laboratory drying oven (binder) at 50ºC for 12 and 14 hours.

Some chemical analysis of fresh and dried beef sausage at zero time, 25 days and 50 days:

Chemical composition (moisture, protein, fat and ash) of fresh and dried beef sausage treatments was determined according to A.O.A.C (2000). Total carbohydrates were calculated by difference as follows:

Total carbohydrates = 100 – (moisture + protein + fat + ash).

Some physical analysis of fresh and dried beef sausage:

Water holding capacity (WHC) and plasticity of fresh and dried beef sausage treatments measured according to the filter press method of Soloviev (1966). pH determination was carried out according to (Keton and Melton, 1978).

Total volatile nitrogen (T.V.N.) determination was carried out according to the method published by Winton and Winton (1958).

ThioBarbituric acid (T.B.A.) determination was carried out according to the method described by Egan *et al.,* (1981).

Sensory evaluation was evaluated according to (Suderman, *et al.,* 1981). Samples were prepared by drying for 12, 14 hours and subjected to 10 member trained sensory panel to find out the product that has more palatability by evaluation color, odor, taste, texture and overall acceptability.

Microbiological safety:

Total bacterial count (T.B.C.) was carried out according to the procedures described by APHA (1976) and DIFCO Manual (1984). Incubation were carried out at 37ºC/48 hrs.

MacConkey agar count (MAC), plates were poured to assure that all the samples at zero, 25 and 50 days were coliform – free and microbiologically safe for consuming. That is according (APHA, 1976).

Water activity (a_w) was determined according to Cadden (1988). To help us understand how this type of sausage kept itself longer at ambient temperature.

Results and Discussion

Chemical composition of fresh and dry beef sausages at zero time, 25 days and onset of spoilage (50 days):

Table (1) showed moisture, protein, fat, ash and carbohydrates content of fresh beef sausage which were 59.30, 20.65, 15.50, 1.92 and 2.63%, respectively. While for 12 hour drying and 14 hour drying were 37.88, 40.70, 13.86, 3.09% and 4.47; 33.50, 43.55, 12.95, 5.09 and 4.91% respectively.

These results reflect that the drying of beef sausages causes a decrease in the moisture while the other components increase such as protein, ash and carbohydrates while the fat decreased from the drying heat. Also,

from these results, it could be noticed that moisture and fat contents gradually decreased as time passed till onset of spoilage. Apart from the fresh sample protein, ash and carbohydrates contents increased.

The water activity (a_w) for the freshly dried samples for 12 and 14 hour were 0.81, 0.86 respectively while water loss% were 36.1% and 43.5% respectively.

a_w for 25 days samples for 12 and 14 hours were 0.83 and 0.89 respectively while water loss% were 37.1% and 45.8% respectively. a_w for 50 days samples (onset of spoilage) were 0.91 and 0.94 respectively. While water loss% were 38.4% and 46.5% respectively according to Heniz and Hautzinger (2007) our samples are microbiologically safe for human consumption.

Table 1: Chemical composition of fresh and dry beef sausages (%) at zero time, 25 days and onset of spoilage (50 days).

Component	Fresh sausage	Zero time		25 days		Onset of spoilage (50 days)	
		12 hour drying	14 hour drying	12 hour drying	14 hour drying	12 hour drying	14 hour drying
Moisture	59.30	37.88	33.50	37.31	32.09	36.53	31.65
Protein	20.65	40.70	43.55	41.03	43.80	41.10	43.36
Fat	15.50	13.86	12.95	13.77	13.25	13.15	12.98
Ash	1.92	3.09	5.09	3.12	5.14	3.18	5.20
Carbohydrates	2.63	4.47	4.91	4.77	5.72	6.04	6.81
a_w	----	0.81	0.86	0.83	0.89	0.91	0.94
Water loss %	----	36.1	43.5	37.1	45.8	38.4	46.5

Changes in some chemical properties of fresh and dry beef sausages at zero time, 25 days and onset of spoilage (50 days):

From the results represented in Table (2), it could be noticed that, total volatile nitrogen (TVN) of all sausage treatments ranged from 8.04 to 8.17 mg/100g at zero time. While the results ranged from 9.32 to 9.42 mg/100g on 25 days and onset of spoilage (12, 14 hour drying) 16.51 to 18.03 mg/100g.these values increased gradually with increasing storage period. TVN values of all treatments were in the range of permissible level reported by Egyptian Standards Specification (2005) which indicated the content of TVN must not be over than 20 mg/100g. These results are similar to that obtained by Ibrahim (2004) and Girgis, *et al.,* (2015). Also, from the same Table, it could be observed that Thiobarbituric acid values (TBA) of all treatments at zero time, 25 days and onset of spoilage ranged from 0.22 to 0.29 (at zero time), 0.34 to 0.39 on 25 days, onset of spoilage 12,14 hour drying- 0.40-0.44 mg malonaldhyde/kg. the lowest (TBA) values recorded for fresh beef sausage at zero time, meanwhile, the highest increment of TBA values recorded for onset of spoilage which reached 0.44 mg malondhyde/kg (after 50 days).

Table 2: Changing in some chemical properties of fresh and dry beef sausages at zero time, 25 days and onset of spoilage (50 days).

Keeping time	Fresh sausage		12 hour drying		14 hour drying	
	TVN	TBA	TVN	TBA	TVN	TBA
Zero time	8.04	0.22	0.08	0.27	8.17	0.29
25 days	----	----	9.32	0.34	9.42	0.39
Onset of spoilage (50 days)	----	-----	16.51	0.40	18.03	0.44

TVN: Total volatile nitrogen (mg/100g), TBA: Thiobarbituric acid (mg malonaldhyde/kg)

Water holding capacity (WHC) and plasticity of sausages:

Table (3) shows the water holding capacity (WHC) and plasticity of fresh beef sausage, 12 hour drying and 14 hour drying at zero time, 25 days and onset of spoilage (50 days) where: water holding capacity (WHC) for fresh beef sausages was 2.8cm^2/0.3g while was 1.9 cm2/0.3g (12 hour drying), 2.3 cm2/0.3g (14 hour drying) all at zero time. These results may be due to the action of drying and may be attributed to protein denaturation and loss of protein solubility (Osheba *et al.,* 2013). Also, it could be noticed from the same Table on 25 days and onset of spoilage (WHC) were 2.3 – 3.0 cm^2/0.3 g for 12 hour and 14 hour drying 2.7 – 3.61cm^2/0.3g onset of spoilage respectively. While, Plasticity values took the same trend of WHC, meanwhile plasticity values decreased by increasing hours of drying period. This behavior may be due toprotein denaturation and loss of protein solubility.

Table 3: Water holding capacity (WHC) and plasticity of fresh beef sausage, 12 and 14 hour drying at zero time, 25 days and onset of spoilage (50 days).

Keeping time	Fresh sausage		12 hour drying		14 hour drying	
	WHC	Plasticity	WHC	Plasticity	WHC	Plasticity
Zero time	2.8	3.2	1.9	2.9	2.3	2.5
25 days	----	----	2.3	2.2	3.0	2.20
Onset of spoilage (50 days)	----	-----	2.7	2.0	3.61	1.65

From the data represented in Table (4), it could be noticed that acidity increases along its both hours of drying and days of preservation, this may occur due to some concentration happened during drying and the loss in moisture also to the microbial growth throughout the storage period at ambient temperature.

In a study made by Hienz and Hautzinger, 2007, they stated that due to the decreasing water content, the pH environment inside and on the surface of the meat decreased below 5.5, this makes the environment inhabitable from food pathogens such as *E.coli0157:H7*, *Salmonella sp.*and *Listeria monocytes* making this sausage type safe for human consumption.

Table 4: Changing in pH values of fresh and dry beef sausage at zero time, 25 days and onset of spoilage (50 days).

Keeping time	Zero time	12 hour drying	14 hour drying
Fresh sausage	4.91	4.72	4.54
25 days	----	4.56	4.45
Onset of spoilage (50 days)	----	4.35	4.25

Data in Table (5) shows the total plate count (TPC) and MacConkeyagar count (MAC) of fresh, 25 days and onset of spoilage (50 days) of beef sausage at fresh, 12 and 14 hour of drying. It could be noticed that the TPC for fresh sausages was 1.8×10^4cfu/sample, while decreased to $9.1\times10^3$and 7.3×10^3cfu/sample for fresh samples dried at 50ºC for 12 and 14 hours. After 25 days on ambient temperature, TPC reached 4.2×10^5 and $2{,}8\times10^5$cfu/sample for the same samples. At onset of spoilage TPC raised up to 9.1×10^6 and8.0×10^6cfu/sample.

MacConkey agar count (MAC) is nil in all the samples under this study which reflects good manufacturing condition that led to such result.

Table 5: Total plate count (TPC) and MacConkey agar count (MAC) of fresh, 25 days and onset of spoilage (50 days) of beef sausage at zero time, 12 and 14 hour of drying.

Keeping time	Zero time		12 hour drying		14 hour drying	
	TPC (cfu)	MAC (cfu)	TPC (cfu)	MAC (cfu)	TPC (cfu)	MAC (cfu)
Fresh sausage	1.8×10^4	nil	9.1×10^3	nil	7.3×10^3	nil
25 days	n.a.	nil	4.2×10^5	nil	2.8×10^5	nil
Onset of spoilage (50 days)	n.a.	nil	9.1×10^6	nil	8.0×10^6	nil

na.: Non applicable

Table (6) shows the sensory properties of fresh, 25 days and onset of spoilage (50 days) beef sausages. It could be noticed that there is not a great difference for all the properties (color, taste, odor and texture) between fresh and 25 days samples. The great difference occurred after 50 days of preservation at ambient temperature.

The 12 hour drying period samples scored better than 14 hour samples in all the parameters tested, so, the 12 hour drying period samples are the recommended.

Table 6: Organoleptic characteristics of fresh, 25 days and onset of spoilage (50 days) beef sausages at zero time, 12 and 14 hour of drying.

Properties	Fresh		25 days		Onset of spoilage (50 days)	
	12 hour drying	14 hour drying	12 hour drying	14 hour drying	12 hour drying	14 hour drying
Color	7.5	6.8	7.1	6.2	4.8	5.2
Taste	9.0	6.8	8.8	6.5	Acidic	Acidic
Odor	8.5	7.5	8.3	7.3	2.5	2.6
Texture	8.0	6.8	8.0	6.6	3.7	3.8
Overall acceptability	7.9	6.9	7.8	6.8	2.0	2.3

Conclusion:

From all the above data in this work, it could be concluded that the dry sausage is good for all purposes especially going outs and tours without the need of cooking. The 12 hour drying time sample was better than the 14 hour sample in sensory characteristics. Subsequently, it can be recommend that dry sausage is self-preserved at ambient temperature and no need to keep it under cooling or freezing condition and it is considered safe from the microbiological point of view until (50 days), as long as pH is below 5.5, the moisture loss is between 25-50% and water activity (a_w) ranged between 0.85 to 0.91. our product achieved 4.72, 4.54 pH; 36.1%, 43.5% moisture loss and 0.81, 0.86 a_w for the freshly dried samples for 12 and 14 hours respectively, also 4.56, 4.45 pH; 37.1%, 45.8% moisture loss and 0.83, 0.89 a_w for 25 days samples for 12 and 14 hours respectively, finally 4.35, 4.25 pH; 8.4%, 46.5% moisture loss and 0.91, 0.94 a_w for 50 days samples for 12 and 14 hours respectively.

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