Flavour intensity and acceptability evaluation of smoked sausages

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A b s t r a c t: This study was conducted to investigate the effects of different spices on the flavour intensity and acceptability of cooked, smoked sausages. A total of 112,944.51g meat block was prepared containing 80/20 pork trim 56,245,46 g (49.8%) 80/20 beef 28,576.32 g (25.30%) and 50/50 pork trim 28,122.73 g (24.89%) to form batter with 11,339.80 g (10%) water, 2,494.76 g (2.2%) salt, 2,267.96 g (2%) corn sytrup solids, 1,153.98 g (1%) dextrose, 294.83 g (0.26%) ground black pepper, 2500 ppm (283.50 g; 0.25%) sodium phosphate, 156 ppm (283.50 g; 0.25%), curing salt, (6.25% NaN0$_2$), and 547 ppm (56.70 g; 0.05%) sodium erythrobate. The batter was divided into five treatments. Thus, T1 Wisconsin style = batter + coriander + msg + ground celery; T2 = andouille = batter + red pepper, white pepper + garlic powder + ground thyme + onion powder; T3 chipotle = batter + chilli powder + ground chipotle pepper + garlic powder+ smoke flavouring powder + ground oregano; T4 old fashioned = batter + msg + ground nutmeg; T5 whiskey fennel = batter + whiskey + dextrose (0.60) + whole fennel. The sausages were stuffed into natural hog casing (32–35mm), hand linked and smoked cooked at 85°C for 150 min and 78% humidity to 70°C internal temperature, cold showered and kept overnight. They were oven-warmed and evaluated for flavour intensity and preference by a 10-member taste panel using a hedonic scale on which 1 = not intense and 10 = intense, while the preference ranked on the scale on which 1 = favourite and 5 = least favourite. The results showed that T2 had the most intense flavour (p<0.05), while T1 was most preferred (p<0.05) and T4 was least preferred. It is suggested that changing the spices to create varieties of sausages for consumers be encouraged and that T1, T2 and T3 be given wider publicity for consumer acceptability in order to increase their production and placement on the market and to provide better justification and recommendation from a marketing strategy aspect.

Keywords: evaluation, flavour intensity, preference, smoked sausage, spices.

Introduction

Sausage is one of the earliest forms of food processing and became an art distinctive to particular locations during the Middle Ages and as a means of preserving meat. Sausage is minced meat or a combination of meats blended with seasonings and spices stuffed into a casing or container (*Savell and Smith,* 2009). It consists of communited meats ranging from coarsely ground to fine emulsions such as hot dogs or bologna, and products can be cured, smoked or heat processed and be fresh, dry, semi-dry or fermented sausages. Each product has its own processing method with intricacies and tradition according to Sausage Technology Journal (*STJ*, 2008). Smoked sausages are very popular and are of two types, uncooked and cooked; uncooked smoked sausages are made from cured or uncured meat that is ground and mixed with spices, salt or other non-meat items and stuffed into casings to form sausages that are then smoked and refrigerated. Cooked smoked sausages include emulsion type and coarse ground sausages (*Topel et al.*, 2013).

Sausages are made to add value, apart from storing meat and to produce products with variety and unique tastes. The unique taste comes largely from

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spices that add flavour to sausages, according to Basic Sausage Making (*BSM*, 2004). The increased interest in food with healthy properties has led to many studies on meat products in which meat is integrated or substituted at different levels with other ingredients, such as fibre, cereals or nuts *David et al.*, (2019). It was reported that healthier frankfurters could be produced by incorporating walnut and fat into the product *(Ayo et al.,* 2008; *Jimenez-Colmenero et al.,* 2010). The growing trends in development of dietary fibre-rich meat products as well as advances in ingredient and processing systems for meat and meat products have given way for varieties of sausages to be produced (*Mehta et al.,* 2015; *Weiss et al.,* 2010). Also, the presence of non-meat ingredients or additives are usually adopted to improve shelflife and food safety, even though consumers are interested in healthier meat and meat products either without synthetic additives or with natural substitutes that could increase aspects of both commercial stability and safety (*Roila et al.*, 2008; *Agregan et al.*, 2019). It was reported by *Apata et al.* (2006) that spices had a significant influence on the flavour of cooked meat, and that flavour is one of the most cherished eating qualities of meat products, as stated by consumers (*Apata et al.*, 2014). However, there are scanty reports of the effects of spices on the acceptability of flavour of cooked, smoked sausages in the literature, so to fill the gap, this study, therefore, investigated the effects of different spices on the flavour intensity and acceptability of smoked sausages.

Materials and Methods

This study was carried out in the Meat Science Laboratory, Iowa State University, United States in July 2018. A total of 112,944.51 g of meat block was prepared containing 80/20 pork, 56,245.46 kg (49.80%), 80/20 beef, 28,576.32g (25.30%) and 50/50 pork trim, 28,122.73 g (24.89%) as shown in Table 1. The ingredient composition of the sausage is presented in Table 2 (*Armstrong*, 2018).

Grinding — Meat block (Table 1) of 112, 944.51 g was ground through a ½ grinder — Hollymatic grinder plate (*Ranucci et al.*, 2018).

Mixing — The ground meats and the ingredients, salt and curing salt (6.25% $NaSO_2$) were added, and the mixture was comminuted in a chopper (Holymatic) for 1 min. Pork trim was added, seasoning and additional water and ice were included and mixed for another 5 min. The batter was reground through a Holymatic 3/16" mixer grinder plate. (*Ranucci et al.*, 2018).

Division of batter — The batter was divided into five portions of 22,588.90g representing five treatments. Each batter treatment was transferred into the mixer and the non-meat ingredients in each treatment were added and the whole mixed further for 2 min. Next, each of the batter treatments was

Table 1. Composition of the meat block

Meat	Grams	%
Total meat block	112,944.51	–
Pork 80/20	56,245.46	49.80
Beef 80/20	28,576.32	25.30
Pork trim	28,122.74	24.90

Table 2. Ingredient composition of the sausage batter

Ingredient	PPM	Grams	% of Meat Block
Meat block	–	112,944.51	–
Water	–	11,339.80	10.04
Salt	–	2,494.76	2.21
Corn Syrup Solids	–	2,267.96	2.01
Dextrose	–	1,153.98	1.02
Ground Black Pepper	–	294.83	0.26
Sodium Phosphate	2,500	283.50	0.25
Curing Salt (6.25%)			
Sodium nitrite	156.00	283.50	0.25
Sodium Erythrobate	547.00	56.70	0.05

Legend: PPM = parts per million

transferred into a clean bucket, hand mixed properly to further homogenise the batter with the ingredients (*Savel and Smith* 2009, *Armstrong*, 2018) and allotted to sausage treatments as follows:

- T1 Wisconsin style = batter + coriander + monosodium glutamate (MSG) + ground celery
- T2 Andouille (Cajun) = batter + red pepper + white pepper + garlic powder + ground thyme + onion powder
- T3 Chipotle = batter + chill powder + ground chipotle pepper + garlic powder + smoke flavouring powder + ground oregano
- T4 Old fashioned = batter + monosodium glutamate (MSG) + ground nutmeg
- T5 Whiskey fennel = batter + whiskey + dextrose (0.60) + whole fennel

Stuffing — Each of the batch/treatments was fed into a Talsa Piston and stuffed into natural hog casings (32–35 min) following the procedures of *Savel and Smith* (2009).

Linking and Thermal Processing/Cooking — The stuffed sausages were linked manually and hung on a smokehouse truck with 10 rods ready for thermal processing. The linked sausages were allowed to stand in the processing room at a temperature of 7.22°C for between 30–60Xmin before being moved into a smoke house (Mauer) and cooked/smoked for 150 min (2 h, 50 min) at 85°C and 78% relative humidity (RD) to 70°C internal temperature according to *Savel and Smith*, (2009).

Cold Shower and Standing — This was done on and off at 1 min intervals with cold water. The cooked, smoked sausages were allowed to stand overnight before peeling (*Savel and Smith*, 2009).

Peeling — The sausages were warmed, one batch/treatment after the other, and were manually peeled then allowed to cool before serving for organoleptic evaluation (*AMSA*, 2015; *Lawrie and Ledward*, 2006).

Sensory Evaluation

Each of the sausage batches/treatments was warmed in an electric oven at 160°c for 5 min and sliced onto dishes. A 10-member taste panel comprising students and staff of Department of Animal Science (Meat Science Laboratory) of Iowa State University Ames evaluated the sausages for flavour intensity using a 10-point hedonic scale in which 1 = not intense and 10 = intense. Panel members also marked their preference ranking on a 5-point hedonic scale in which 1 = favourite and 5 = least favourite following procedures of AMSA (2015).

Experimental Design and Statistical Analysis

The experimental design for this study was completely randomized design. One way analysis of variance (ANOVA) was used (*Genstat,* 2009) and all significant means were separated with the Duncan's multiple range test of the same software at $p<0.05$.

Results

Figure 1. presents the results of the mean interaction between the sausage treatments.
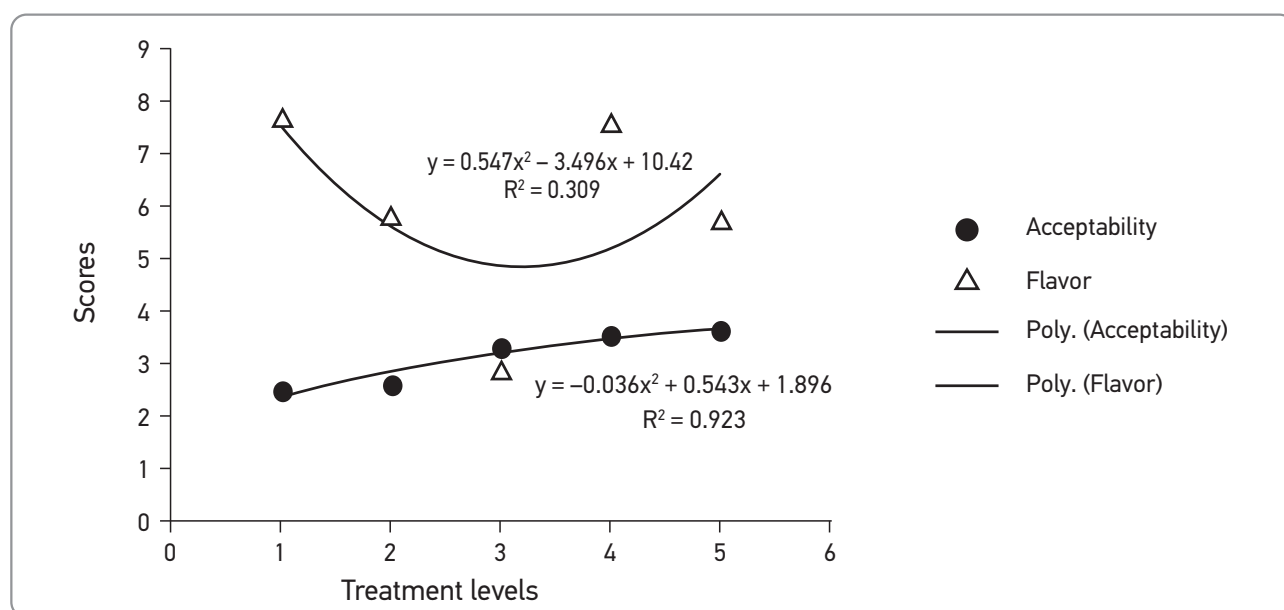
Figure 1. Relationship among the treatment organoleptic scores with increasing level of treatment and preference/acceptability and flavor.
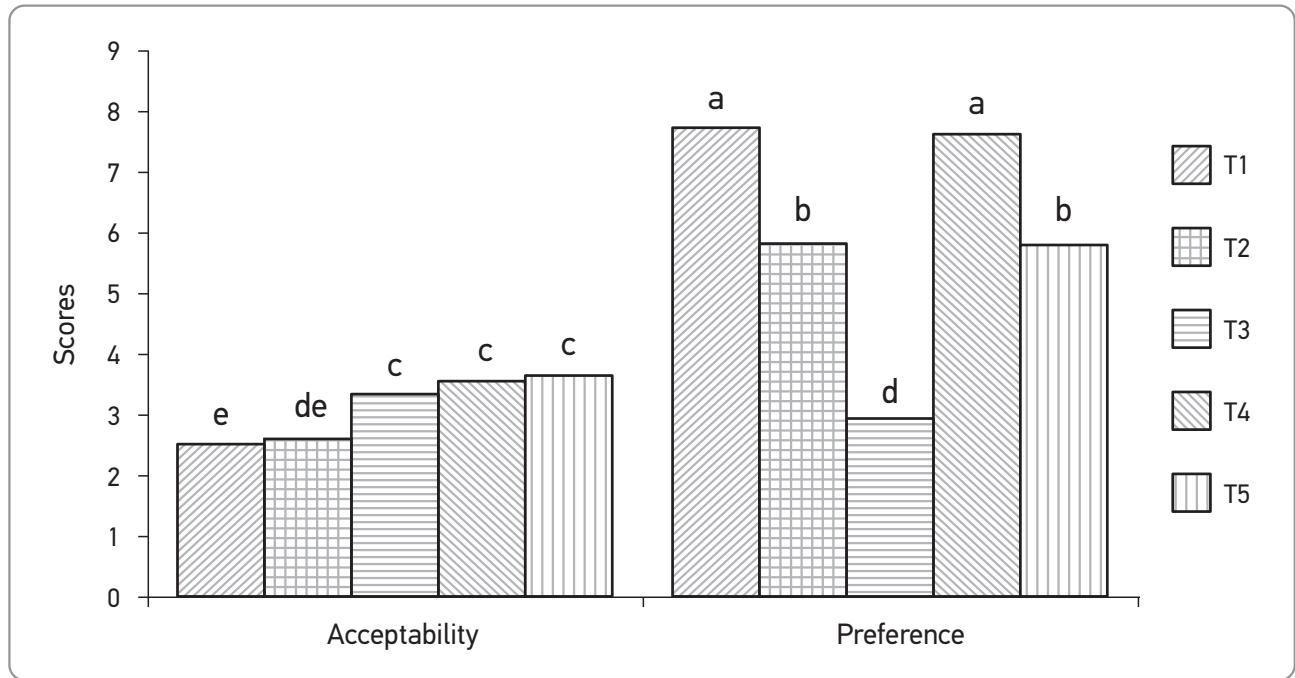
Figure 2. Acceptability and preference scores and statistical differences of the different score types between the different sausage treatments. Scores for sausage types with the same letters (a-e) are not statistically different. T1-T5: see Materials and Methods.

It was observed that the relationship between the treatments was best explained by a quadratic equation which captured about 30% of the variation in scores for flavour.

The statistical significance of differences in the acceptability and preference scores between the different treatments are presented in Figure 2.

Discussion

The same quadratic equation captured about 92% of the variation in the scores for acceptability. This implied that with increasing treatment levels from T1 to T5, the scores for flavor initially experienced a decline then followed by increase ($p<0.05$). The lowest ($p<0.05$) score for flavour was observed between the third (T3) and fourth (T4) treatment levels. The acceptability scores however, increased ($p<0.05$) with the increasing treatment level, which might likely decline at a higher treatment level. The good flavour scores for T2 and T3 might be due to inclusion of white pepper, garlic, thyme and onion in the ingredient mix for T2 and chipotle pepper, smoke flavouring powder and oregano in T3, which gave the sausages in these treatments their characteristic, highly-scored flavours (*Heinz and Haurtzinger*, 2010). Also garlic and oregano were reported to add desirable flavour to food (*Topel et al.*, 2013; *Ranucci et al.,* (2015).

The scores for acceptability were generally low compared with the flavour scores. Among the preference scores, T1, T3 and T4 were significantly ($p<0.05$) more preferred than T2 and T5. For flavour, inconsistent scores were observed for T3 while T1 and T4 as well as T2 and T5 had similar ($p>0.05$) scores; thus, the paired treatments produced similar results. The higher preference scores observed in T1, T3 and T4 could be as a result of a long-standing habit of consuming Wisconsin style, chipotle and old fashioned sausages by the majority of members of the taste panel, despite the andouille sausage (T5) receiving a higher flavour score than the chipotle sausage (T3). It was reported by *Apata et al.* (2016) that it is difficult, once they are formed, to sever people's habits of consuming a particular meat or food. However, in another work involving the use of another spice/additive, it was reported that consumers could change their inherent habit of consuming one particular meat product, depending on the major characteristics of the product, such as texture, juiciness, flavour and appearance (*Mendez-Zamora et al.*, 2015). Therefore, the overall acceptability of any meat product would be decided by consumers based on the eating qualities of such a product, not necessarily on the eating habits of the consumers. It can be deduced from the results of this study that sausages of Wisconsin style, chipotle and old fashioned sausages, in that order, were highly accepted by the taste panel mem-

bers. This might not merely be due to the fact that the panel members had formed their habits with regard to consuming these sausage types, but perhaps due to the fact that these types of sausages are relished for their eating qualities as evident in this study.

Conclusion

It can be concluded from the results of this study that andouille followed by chipotle was the favourite sausage in terms of flavour, perhaps as a result of the full balance of ingredients in the mix, while the acceptability was highest for Wisconsin style followed by chipotle and old fashioned, probably due to an outstanding habit of consuming these sausages and despite the higher flavour score of our andouille sausage. This suggests that spices can be changed to create varieties of sausage to encourage consumer acceptability while T1, T2 and T3 should be given wider publicity that would raise consumer awareness of these products; this is in order to increase production and marketability.

Ocena intenziteta ukusa i prihvatljivosti dimljenih kobasica

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A p s t r a k t: Cilj ove studije je bio ispitivanje efekata različitih začina na intenzitet ukusa i prihvatljivost kuvanih, dimljenih kobasica. Pripremljeno je ukupno 112.944,51 g mesnih blokova koji sadrže 80/20 trima svinjskog mesa 56.245,46 g (49,8%), 80/20 junećeg 28.576,32 g (25,30%) i 50/50 trima svinjskog mesa 28.122,73 g (24,89%), kako bi se napravila smesa sa 11,339,80 g (10%) vode, 2.494,76 g (2,2%) soli, 2.267,96 g (2%) čvrste supstance kukuruznog sirupa, 1.153,98 g (1%) dekstroze, 294,83 g (0,26%) mlevenog crnog bibera, 2500 ppm (283.50 g; 0,25%) natrijum fosfata, 156 ppm (283,50 g; 0,25%), soli za sušenje, (6,25% NaN02) i 547 ppm (56,70 g; 0,05%) natrijum eritrobata. Smeša je podeljena u pet tretmana. Dakle, T1 Viskonsin stil = smeša + korijander + msg + mleveni celer; T2 = Andouille = smeša + crvena paprika, beli biber + beli luk u prahu + mlevena majčina dušica + crni luk u prahu; T3 Chipotle = smeša + čili u prahu + mlevena chipotle paprika + beli luk u prahu + prah arome dima + mleveni origano; T4 tradicionalni tretman = smeša + msg + mleveni muškatni oraščić; T5 Viski komorač = smeša + viski + dekstroza (0,60) + ceo komorač. Kobasice su punjene u prirodnom svinjskom omotaču (32–35mm), ručno povezane i dimljeno kuvane na 85°C, 150 min i 78% vlažnosti do unutrašnje temperature 70°C, tuširane na hladno i držane preko noći. Zagrejane su u rerni i ocenjivanje u pogledu intenziteta i preference ukusa od strane 10-članog panela za ukuse koristeći hedonističku skalu na kojoj je 1 = nije intenzivan, a 10 = intenzivan, dok je preferenca rangirana na skali na kojoj je 1 = omiljeni a 5 = najmanje omiljeni. Rezultati su pokazali da je T2 imao najintenzivniji ukus (p<0,05), dok je T1 bio najpoželjniji (p<0,05), a T4 je bio najmanje poželjan. Predlaže se korišćenje začina za kreiranje vrsta kobasica za potrošače, kao i da T1, T2 i T3 dobiju širi publicitet sa stanovišta prihvatljivosti potrošača, kako bi se povećala njihova proizvodnja i plasman na tržište i dalo bolje opravdanje i preporuka iz aspekta marketinške strategije.

Ključne reči: Evaluacija, intenzitet ukusa, preferenca, dimljena kobasica, začini.

Disclosure statement: No potential conflict of interest was reported by authors.

References

Agregan, R., Barba, F. J, Gavahian, M, Franco, D, Khaneghah, A. M, Carballo, J, Ferreira, I.C.F.R. Ola Silva Bametto, A.C. & Lorenzo, J. M (2019). *Fucus vesiarlosus* extracts as natural antioxidants for improvements of physicohemical properties and shelf-life of prok patties formulated with oleogels. *Journal of the Science of Food and Agriculture*, 99,4561–4570.

AMSA (2015). Research guidelines for cookery, Sensory evaluation and Instrumental tenderness measurement of meat, American Meat Science Association Chicago, IL, USA

Apata, E. S., Omojola, A. B., Akinfemi, A. & Osineye, O. M. (2006). Effects of four different additives on organoleptic charactertistics of Red-Sokoto and West African Dwarf buck meat. *Journal of Agriculture Forestry & Social Sciences*, 4 (1), 175–181.

Apata, E. S., Eniolorunda, O.O., Apata, O. C., & Eso, L. B. (2014). Utilization and influence of condiments prepared from fermented legumes on quality profile of meat. *Journal of Food Research*, 3 (5), 113–119.

Apata, E. S., Akinbinu, J. B., Apata, O.C., Dada, O. M. & Aderinto, A. (2016). Evaluation of socio-economic characteristics, preference and consumption pattern of meat among the inhabitants of Yewa in Ogun State, Nigeria. *Assiut Journal of Agriculture Sciences*, 47 (6–2), 546–554.

Armstrong, B. (2018). Sausage Flavours, Silver Group Project. Iowa State University 40th Annual "Sausage and Processed Meats" Short Course, Master Blend of Sausage, Unpublished Laboratory Manual, 1–20.

Ayo, J., Carballo, J. Solas, M. T. & Jimenez-Colmenero, F. (2008). Physicochemical and sensory properties of healthier frankfurters as affected by walnut and fat content. *Food Chemistry*, 107, 1547–1552.

Genstat (2009). Genstat 12th Edition PC/Window Vitsa. VSN International Ltd. The NULL Corporation. Genstat Procedure Library Release PL 20.1.

Heinz, G. & Hautzinger, P. (2010). Meat Processing Technology for Small to Medium Scale Producers. Food and Agriculture Organisation of the United Nations Regional Office for Asia and the Pacific Bangkok, Thailand, 230–246.

Jimenez-Colemnero, F., Sanchez-Muniz, F. J. & Olmedilla-Alonso, B. (2010). Design and development of meat-based functional foods with walnut: Technological, nutritional and health impact. *Food Chemistry*, 123, 959–967.

Lawrie, R. A. & Ledward, D. A. (2006). Lawrie's Meat Science. Woodhead Publishing Limited, Cambridge, England, 358–366.

Mehta, N., Ahlawat, S. S., Sharma, D. P. & Dabur, R. S. (2015). Novel trends in development of dietary fibre rich meat products- a critical review. *Journal of Food Science and Technology*, 52, 633–647.

Mendez-Zamora, G., Garcia-Macias, J. A. Santellano-Estrada, E., Chavez-Martinez, A., Duran-Melendez, L. A., Silva-Vazquez, R. & Quintero-Ramos, A. (2015). Fat reduction in the formulation of frankfurter sausages using mulin and pectin. *Food Science and Technology*, 35, 25–31.

Ranucci, D., Miraglia, D., Trabalza-Marinucci, M. Acuti, G., Codini, M., Ceccarini, M. R, Forte, C. & Branciari, R. (2015). Dietary effects of Oregano (*Origanum vulgaris L*) plant or sweet chestnut (*Castanea sativa* Mill) wood extracts on microbiological, chemicophysical characteristics and lipid oxidation of ham during storage. *Italian Journal of Food Safety*, 4, 5497.

Ranucci, D., Miraglia, D., Branciari, R., Morganti, G., Roila, R., Zhou, K., Jang, H. & Braconi, P. (2018). Frankfurters made with port meat, enmer wheat (*Triticum dicoccum* Schubler) and almond nut (*Prunus dulcis* Mill): Evaluation during storage of a novel food from an ancient recipe. *Meat Science*, 145, 440–446.

Roila, R., Branciari, R., Staccini, B., Ranucci, D., Miraglia, D., Altissimi, M. S., Mercuri, M. L. & Haouet, N. M. (2018). Contribution of vegetables and cured meat to dietary nitrate and nitrite intake in Italian population: Safe level for cured meat and controversial role of vegetables. *Italian Journal of Food Safety*, 7, 7692.

Savell, J. W. & Smith, G. C. (2009). Meat Science Laboratory Manual 8th Edition. American Press, Boston, M.A, USA, 109–128.

STJ, (2008). Sausage 101. The national provisioner. The authority of the business of meat and poultry processing. *Sausage Technology Journal*, 1, 2–12.

Topel, D. G, Marple, D. N., Lonergan, S. M. & Parrish, Jr. F. C. (2013). The Science of Animal Growth and Meat Technology, 180–199.

Weiss, J., Gibis, M., Schuh, V. & Salminen, H. (2010). Advances in ingredients and processing systems for meat and meat products. Meat Science, 86, 196–213.