J.Meat Sci., 2015, 11(1) : 39 - 42

Research Paper

Nutritional and Sensory Quality and Heavy Metal Contents of Commercial Pork Products in West Bengal

J. Chowdhury, R. Chakraborty, S. Biswas[*1], S. Sahoo[2] and S.K. Das[3]

Dept. of Food Technology and Bio-chemical Engineering, Jadavpur University, Kolkata
1Directorate of Research, Extension and Farms, WBUAFS, Belgachia, Kolkata
2 Department of Fishery Economics & Statistics, WBUAFS, Kolkata
3 Department of LPT, WBUAFS, Kolkata

ABSTRACT

A study was conducted to evaluate proximate composition, fatty acids and energy contents, heavy metal contents and consumer acceptance of ham, salami, sausages and nuggets produced at meat plant (bacon factory), Haringhata Farm, West Bengal. The mean of moisture (56.47 ± 0.150 to 64.70 ± 0.159), protein (16.23 ± 0.147 to 26.91 ± 0.145), total lipids (8.91 ± 0.129 to 18.87 ± 0.097) , mono unsaturated fatty acids (MUFA) (4.07 ± 0.028 to 8.87 ± 0.026), poly unsaturated fatty acids (PUFA) (0.95 ± 0.013 to 2.31 ± 0.027), saturated fatty acids (SFA) (3.04 ± 0.011to 6.83 ± 0.012), cholesterol (47.24 ± 0.128 to 62.11 ± 0.148) and energy content (191.60 ± 2.02 to 254.20 ± 2.01) were recorded. Heavy metal contents like copper (Cu) (0.74 ± 0.008 to 0.97 ± 0.009) and zinc (Zn) (5.59 ± 0.068 to 12.70 ± 0.132) were also recorded. Lead (Pb), arsenic (As) and tin (Sn) contents were at below detectable level (BDL). Proximate compositions were significantly ($p<0.05$) different among all products. Significant difference ($p<0.05$) has been observed for MUFA and PUFA in all products excepting in between ham and nuggets. SFA was significantly different ($p>0.05$) among all the products. Whereas cholesterol content did not differ significantly in between salami and sausages and energy content did not differ significantly in between ham and salami. Products were free from Pb, As and Sn contents. Organoleptic evaluation showed that over all acceptability did not differ significantly ($p>0.05$) in salami, sausages and nuggets though it differed significantly when compared with ham.

Keywords : *Pork products, Proximate compositions, Fatty acids, Energy, Heavy metal, Sensory quality*

Received : 22.03.2015 Accepted: 22.08.2015

INTRODUCTION

Numbers of exotic pig farms have been developed at different pockets of the country through piggery development scheme (PDS) from 2nd five year plan onwards and simultaneously 8 bacon factories were established at different parts of the country with the objectives to provide a steady market to the private pig growers as well as to supply valuable animal protein to the consumers at a reasonable cost. These bacon factories played a major role for introduction and popularization of pork and pork products in the country over the decades earlier. The effort of these factories is one of the major factors why like western countries both raw pork items like fresh pork, lean pork, pork chops etc., and processed ready to eat items viz. ham, bacon, salami, sausages, frankfurter, luncheon meat, nuggets etc. have also become a part of Indian way of life. However, the Indian market for processed pork products is still small, and the majority of this market is supplied through imports.

Proximate composition of different pork products were studied by Dale *et al*. (1993), Jihad *et al*. (2009), Lucarini*et al*. (2013) and Kuzelov *et al*. (2012). However, scientific data in this respect of lipid profile and energy content, heavy metal composition and sensory evaluation of pork products more specifically in India or West Bengal condition is inadequate. Hence, the present study was undertaken to evaluate the nutritional and organoleptic quality of some popular pork products in Indian condition.

MATERIALS AND METHODS

Large White Yorkshire pigs of either sex (80 to 90 kg body weight) from piggery section, Haringhata farm of animal resources development department, Government of West Bengal, were slaughtered at different occasions at meat plant, Haringhata and deboned after chilling over night at 4 ± 2°C. Dry salt curing (1.5%) (mixture of common salt 1 kg, sodium nitrate 200 g, sodium nitrite 50 g) of deboned lean meat chunks done for preparation of ham, salami and nuggets. Whereas, fresh chilled deboned meat and fat trimmings used for preparation of sausages. Hams were prepared using S.S. ham moulds. Cured meat chunks were placed in the molds, lids were closed and steam cooking done at 83°C temperature for two and half hour using steam cooker. Then lids were pressed to make out extra drip, cooled and kept in cold store (4 ± 2°C)

*Corresponding author E-mail address: lptsubhasis@yahoo.co.in

for subsequent overnight. Then lids were opened and slicing done using gravity food slicer, vacuum packed and stored in deep freezer at -20°C.

For preparation of salami, cured meat chunks were minced using 8 mm grinder plate in a meat mincer. Other ingredients such as spices (1%), ice flake (10%) and garlic (0.75%) were mixed in a bowl chopper. Meat emulsion was stuffed in Salami guts to form salami rolls, then smoked for 2 hours and cooked in salami cooker at 83^0C temperatures for 40 minutes. After cooking salami rolls were cooled and stored in cold store (4 ± 2°C) overnight and then sliced using meat slicer, vacuum packed and kept in deep freezer for subsequent use.

Meat emulsion for nuggets was prepared using same method as of salamis though ingredients added were tetra sodium polyphosphate (0.5%), whole egg liquid (2.5%), maida (2-5%), spices (1.5%), condiments (2.5%) and ice flakes (10%). Then meat emulsion was filled in S.S. molds and steam cooked at 90°C for 2 hours. Then nuggets molds were cooled, stored at 4 ± 2°C and cut into small cubes, vacuum packed and stored at -20°C for subsequent use.

Fresh chilled meat and trimmings used for preparation for sausages using same method and ingredients as of nuggets adding salt (2%). Meat emulsion stuffed into casings using sausage filler, cooked, chilled, pilled and vacuum packed and kept in deep freezer for subsequent use. The moisture, crude protein, ether extracts and total ash contents of meat samples were determined by the method of AOAC (1995). The analysis of MUFA, PUFA and saturated fatty acids content was performed in accordance with the procedure described by O'Fallon *et al*. (2007).Total cholesterol was determined by using the method as described by Rajkumar *et al*. (2004). Gross energy value was estimated as per standard method. The method of Hall (1997) was followed with some modifications for determination of heavy metals.

A semi trained sensory evaluation panel consisted of teachers and post-graduate students of Livestock Products Technology Department, WBUAFS and regular customers of Haringhata pork products were used for evaluating various pork products. Samples for sensory evaluation were prepared by frying in vegetable oil and then cutting into small identical pieces product wise. Water was provided for mouth wash between the samples. Samples were evaluated for appearance, flavor, juiciness, texture and overall acceptability using an 8 point hedonic scale (8= extremely desirable; 1 = extremely undesirable).

Statistical analysis of data were carried out by one way analysis of variance (ANOVA) as per method described by Snedecor and Cochran (1989) and to compare the means at 5 % level of significance, Tukey's HSD test for equality of variances was employed by using SPSS 16 software package.

RESULTS AND DISCUSSION

The Mean ± SE of moisture, protein and total lipids values in percent are presented in Table 1. It has been observed that nuggets had the highest mean level (64.70 ± 0.159) and sausages had the lowest mean level (56.47 ± 0.150) for moisture; Ham had the highest mean level (26.91±0.145) and sausages had the lowest mean level (16.23±0.147) for protein; Sausages had the highest mean level (18.87± 0.097) and nuggets had the lowest mean level (8.91 ± 0.129) for ether extract. These are in accordance with study made by Lucarini *et al*. (2013). Thus significant difference ($p<0.05$) has been observed among all products for all the proximate composition. Higher fat and lower protein and moisture level in case of sausages may be due to use of fatty trimmings in the composition. Dale *et al*. (1993) also reported that percent moisture and fat content for the cooked fresh pork sausage patties decreased ($p<0.05$) as fat increased. National Pork Board (2010) also reported that percent moisture and fat content for the cooked fresh pork sausage patties decreased ($p<0.05$) as fat increased.

Highest protein content in ham as observed in the present study may be primarily due to use of lean meat cuts as source of meat and secondly due to absence of additives or spices in the recipe which is whole meat product. Proximate composition of salami as observed in the present study is supported by Jihad *et al*. (2009); Kuzelov *et al*. (2012) and Adezei *et al*. (2014) who worked on smoked sausages. The fatty acids, cholesterol energy content (Table 1) indicates that sausages had the highest mean level for MUFA (8.87± 0.026), PUFA (2.31±0.027), SFA (6.83± 0.012) and energy content (254.20± 2.01) which may be due to use of more fatty cuts and trimmings for preparation of sausages. On the other hand ham has the lowest MUFA (4.07±0.028) and energy content (191.60 ± 2.02). However, PUFA (0.95 ± 0.013), SFA (3.04 ± 0.011) and cholesterol (47.24 ± 0.128) content was lowest in case of nuggets. Thus, MUFA and PUFA content differed significantly ($p<0.05$) among all products except in between ham and nuggets. SFA differed significantly ($p<0.05$) among all products. Cholesterol content of salami and nuggets did not differed significantly ($p>0.05$). Whereas, energy content of ham and salami did not differed significantly ($p>0.05$). Thus

lower values of different parameters were observed in case of ham and nuggets which may be due use of more lean cuts for preparation of those products. Cholesterol content of cooked ham in the present study is 62.11 Kcal/100g which is little higher as has been reported by Lucarini *et al*. (2013) which may be due to higher total fat content.

Heavy metal composition (Table 1) of ham, salami, sausages and nuggets depicts that copper (Cu) content ranged in between 0.74 ± 0.008 to 0.97 ± 0.009 and it was highest in nuggets and lowest in ham. Whereas zinc (Zn) content ranged in between 5.59 ± 0.068 to 12.70 ± 0.132 and was highest in salami and lowest in nuggets. Though lead (Pb), arsenic (As) and tin (Sn) contents were at below detectable level in the present study. Higher Zn content in Italian pork salami has been reported when compared with different types of pork sausages (National Nutritional Database, USDA, 2015).

Table 1: Proximate composition, fatty acid, cholesterol, energy and heavy metals content of different commercial pork products (Mean ± SE)

Parameters	Ham	Salami	Sausage	Nuggets
Moisture %	$61.41^{a} \pm 0.149$	$62.32^{b} \pm 0.154$	$56.47^{c} \pm 0.150$	$64.70^{d} \pm 0.159$
Protein %	$26.91^{a} \pm 0.145$	$22.16^{b} \pm 0.156$	$16.23^{c} \pm 0.147$	$19.56^{d} \pm 0.243$
Ether extract %	$9.33^{a} \pm 0.129$	$10.92^{b} \pm 0.108$	$18.87^{c} \pm 0.097$	$8.91^{d} \pm 0.129$
MUFA %	$4.07^{a} \pm 0.028$	$5.06^{b} \pm 0.025$	$8.87^{c} \pm 0.026$	$4.11^{a} \pm 0.028$
PUFA %	$0.96^{a} \pm 0.016$	$1.13^{b} \pm 0.015$	$2.31^{c} \pm 0.027$	$0.95^{a} \pm 0.013$
SFA %	$3.62^{a} \pm 0.028$	$3.41^{b} \pm 0.029$	$6.83^{c} \pm 0.012$	$3.04^{d} \pm 0.011$
Cholesterol (mg/100g)	$62.11^{a} \pm 0.148$	$53.10^{b} \pm 0.125$	$53.16^{b} \pm 0.125$	$47.24^{c} \pm 0.128$
Energy (Kcal/100g)	$191.60^{a} \pm 2.02$	$193.35^{a} \pm 2.01$	$254.20^{b} \pm 2.01$	$233.31^{c} \pm 1.98$
Pb (mg/100g)	BDL	BDL	BDL	BDL
Cu (mg/100g)	$0.74^{a} \pm 0.008$	$0.94^{b} \pm 0.009$	$0.76^{a} \pm 0.008$	$0.97^{b} \pm 0.009$
As (mg/100g)	BDL	BDL	BDL	BDL
Sn (mg/100g)	BDL	BDL	BDL	BDL
Zn (mg/100g)	$9.53^{a} \pm 0.129$	$12.70^{b} \pm 0.132$	$9.94^{a} \pm 0.130$	$5.59^{c} \pm 0.068$

The sensory evaluation scores indicates that appearance scores ranged in between good to excellent and was highest in ham and lowest in salami and differed significantly ($p<0.05$) among all products except in between sausages and nuggets. Highest scores for appearance of salami may be due to uniform round shaped sliced finished pieces with attractive light pink colour. Such colour was obtained in ham also. Flavour scores ranged between slightly desirable to very desirable were significantly lower in salami as compared with other products. The Lowest scores (5.86 ± 0.121) for flavor for salami in the present study may be due to the flavor of garlic and uncommon smoke flavor. Whereas, the highest score for flavor in ham may due to cured meat flavor which was not masked as no spice was used in the ham. This observation is supported by Hui (2007). Texture scores ranged in between slightly desirable to very desirable and was highest in ham and lowest in nuggets. It was significantly different among all products except in between salami and nuggets. Juiciness scores ranged between desirable to very desirable and it was highest in ham and lowest in salami and was significantly higher ($p<0.05$) in ham as compared to other products. Overall acceptability ranged in between moderately acceptable to extremely acceptable and it was highest in ham and lowest in salami and was significantly lower in salami in comparison to other products.

Table 2: Sensory profile analysis of different commercial pork products (Mean ± SE)

	Ham	Salami	Sausage	Nuggets
Appearance	$7.19^{a} \pm 0.109$	$7.28^{a} \pm 0.112$	$5.95^{b} \pm 0.153$	$6.13^{b} \pm 0.142$
Flavour	$7.08^{a} \pm 0.101$	$5.86^{b} \pm 0.121$	$6.66^{c} \pm 0.094$	$6.67^{c} \pm 0.094$
Texture	$6.88^{a} \pm 0.121$	$6.35^{b} \pm 0.135$	$5.55^{c} \pm 0.122$	$6.38^{b} \pm 0.121$
Juiciness	$6.27^{a} \pm 0.112$	$5.84^{a} \pm 0.122$	$6.09^{a} \pm 0.111$	$6.03^{a} \pm 0.112$
Overall acceptability	$7.00^{a} \pm 0.114$	$6.42^{b} \pm 0.151$	$6.02^{b} \pm 0.126$	$6.23^{b} \pm 0.129$

CONCLUSION

From the observations, it can be concluded that moisture, protein and ether extract content may differ significant among ham, salami, sausages and nuggets. Ham may be the choice of pork product nutritionally as it contained highest protein, lowest ether extract and energy content and highest overall acceptability scores. The products were free from residues of heavy metals like Pb, As and Sn. Salami sausages and nuggets are moderately acceptable to very acceptable and ham is very acceptable to extremely acceptable.

ACKNOWLEDGEMENT

The author thanks Dean, faculty of Veterinary Sciences, West Bengal University of Animal and Fishery Sciences, Kolkata and A.R.D. Department, Government of West Bengal for providing necessary facilities.

REFERENCES

Adu-Adjei S, Adzitey F, Ayum TG (2014) The effect of 'Prekese' *Tetrapleura tetraptera*) pod extract on the sensory and nutritional qualities of pork sausage. Global J Anim Scientific Res 2(1):52-57

AOAC (1995) Official Method of Analysis, 16th edn. Association of Official Analytical Chemists, Washington, D C

Cheng CW, Ho CT (1998) The flavor of poultry meat In: Shahidi F (ed). Flavor of meat, meat products and see foods. UK Blackie Academic and Professional, Chapman & Hall London,pp 84-100

Dale LH, Chen CM, Egbert WR, Bradford DD (1993) Low-fat fresh pork sausage production. AlaAgr Exp Sta Bull 620: 3-4

Hall E M (1997) Determination of trace elements in sediments In: Mudroch A, Azcue JM, Mudroch P (eds.) Manual of physicochemical analysis of aquatic sediments. Lewis Publishers, USA, pp 85-145

Hui HY (2007) Handbook of food products manufacturing. Vl (2):303-323

Jihad MQ, Ayman SM, Ali FA (2009) Nutritive value of seven varieties of meat products (sausage) produced in Jordan. Pakistan J Nutr 8: 332-334

Kondiah N (2004) Value added meat products and development of processed meat sector. Nat Prod Radiance 3(4): 281-283

Kuzelov A, Stojanovski M, Savinok O, Nikolova N, Dijana N (2012) Change of chemical constitution of the traditional Macedonian sausage kept of different temperatures. Scientific works of UFTVOLUME L²X- 2012, Food Sci Eng Technol 218-221

Lucarini M, Saccani GD, Evoli L, Tufi S, Aguzzi A, Gabrielli P, Merletta L, Lombardi-Boccia G (2013) Micronutrients in Italian ham: A survey of traditional products. Food Chem 140: 837-842

National Pork Board (2010) Quick facts: The pork industry at a glance

O'Fallon JV, Busboom JR, Nelson ML, Gaskins CT (2007) A direct method for fatty acid methyl ester synthesis: Application to wet meat tissues, oils, and feedstuffs. J Anim Sci 85(6):1511-1521

Rajkumar V, Agnihotri MK, Sharma N (2004) Quality shelf life of vacuum and aerobic packed chevon patties under refrigeration. Asian Aust J Animal Sci 17(4):548-553