

CHEMICAL COMPOSITION AND COLLAGENEOUS CONNECTIVE TISSUE EVALUATION OF COMMERCIAL FRESH GROUND SAUSAGES

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Background

Fresh ground sausages are a coarse comminuted meat product prepared from chopped pork fat and one or more kinds of meat. They are usually seasoned, frequently cured and stuffed into casings. They must be kept refrigerated and thoroughly cooked before eating. Many sausages took on the names of areas where they were thought to have originated, resulting in typical flavors, textures and shapes. Many present-day sausages still carry those names; examples are Tuscan and Calabrian type fresh sausages. In the coarsely ground fresh sausages, where fat is often visible to the consumer, fat levels are limited to 30%, moisture, to 70% and finished product must contain at least 12% protein (BRASIL, 2000). Non-meat protein of either animal, or vegetal source, at level of 2.5%, may be added to fresh sausages (except in the case of sausages characterized as calabrian and tuscan) and may not contain mechanically deboned meat or starch (BRASIL, 2000). Sausage manufactures presently use meat containing large quantities of connective tissue (collagen) to reduce processing costs. The essential amino acid content of collagen represents 6-22% of its total amino acids compared to reference pattern, which represents 36% of "ideal" protein. There is clearly a large reduction in the levels of almost all of those components (BAILEY & LIGHT, 1989). Collagen contains no tryptophan and only very few aromatic or sulphur-containing amino acids. ZARKADAS et al. (1993) suggested that connective tissue contents of meats can be a useful parameter to evaluate their protein quality. The advantages of using collagen determinations to predict PER of meat samples are: no sophisticated instrument, such as an amino acid analyzer, is needed; it is simpler and less expensive; and small processors can easily perform this analysis in their quality-control laboratory. Later testes with sensory panels showed that there is a good negative correlation between taste parameters and the amount of collagenous connective tissue in meat products. In other words, the greater the amount of collagen that is present, the lower the eating quality may be expected to be. The influence of connective tissue on the nutritional and sensory quality have been the basis for the introduction by many countries of regulations requiring maximum contents of collagenous connective tissue protein in meat products. So characteristic is the presence of hydroxyproline in collagen, that it has been used for many years as a mean of determining the amount of collagen present in a tissue (SIMS & BAILEY, 1981).

Objectives

Determine chemical composition, moisture protein ratio, and content of collagenous connective tissue from 4-hydroxyproline amount in commercial fresh ground sausages. Evaluate sensory appearance and offer helpful informations contributing to legislation standards.

Methods

Fifty five fresh ground sausage samples (20 not characterized, 16 tuscan-type, 5 calabrian-type, 3 beef and pork meat mixed, 9 pork meat, 2 poultry meat sausages) from 29 different producers were chemical and visually analysed in Adolfo Lutz Institute during the period of 2000 – 2002. The samples were finely chopped and mixed thoroughly. Chemical analysis of moisture (oven at 102-105°C), protein (Kjeldahl method, factor 6.25) and fat (diethyl ether extractable) contents were determined in duplicate according to INSTITUTO ADOLFO LUTZ (1985) procedures. Hydroxyproline analysis was according to the method described by AOAC (1995). Collagenous connective tissue proteins were determined by multiplying hydroxyproline contents by 8. The analyst, before chopping the fresh sausage samples, evaluated the visual appearance for connective tissue and fat amounts as S=slight, R=regular or M=much; and an overall acceptability value from 1 to 5 (1=worst, 2=bad, 3=regular, 4=good, 5=very good) was attributed to the product, taking in consideration both parameters' results.

Results and Discussion

In Table 1, results showed that values for moisture ranged from 43.4 to 74.3% (6 products were over the 70% limit established by legislation). Fat content ranged from 2.7 to 46.1% (10 over 30%), protein means, from 8.4 to 18.5% (22 below 12%). Moisture-protein ratio (MPR) ranged from 2.9 to 5.9. Collagenous connective tissue (CCT) ranged from 0.7 to 5.4% and calculated collagenous connective tissue per total protein (CCT/P), from 4.3 to 39.8%. Median and average results for fresh sausages revealed values of moisture of 59.7% and 60.0%, fat, 23.4% and 22.6%, total protein, 12.4% and 13.0%, MPR, 4.8 and 4.7, CCT, 1.8% and 2.0%, CCT/P, 15.2% and 16.6%. Coefficients of variation (C.V.) ranged from 12% for moisture to 51% for CCT/P. Great results variability was observed for fat and collagenous connective tissue contents (CCP and CCP/T – Figure 1). There was a good relation between appearance acceptability values, fat and connective tissue amounts attributed by analyst and analytical collagenous connective tissue or fat contents. Usually, samples that reached low appearance acceptability grades, already had a background of consumers' sensorial complaints.

Conclusions

Commercial coarse fresh sausages revealed a great variability on fat and collagenous connective tissue contents. Results showed that minimum protein, maximum moisture and maximum fat limits were not obeyed respectively for 43%, 11% and 18% of the analysed products. This study demonstrated that regulation standards should include maximum collagenous connective tissue amounts for sensory reasons and to minimize deceptive practices regarding fresh ground sausage meat products.

References

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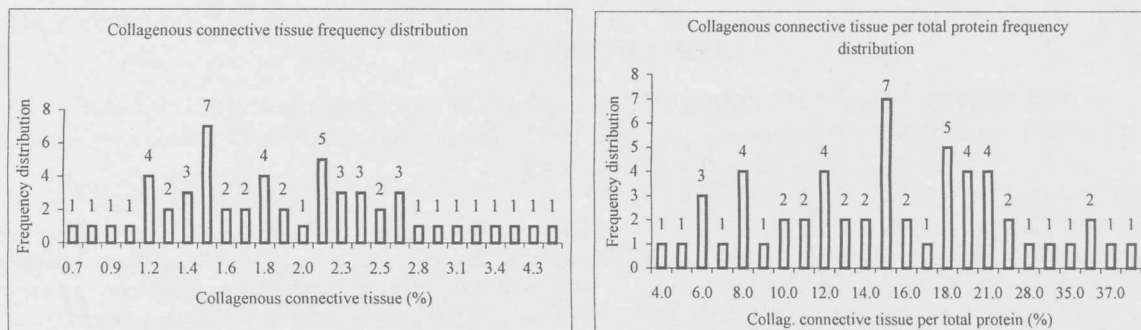


Figure 1. Collagenous connective tissue frequency distribution for commercial fresh ground sausage.

Table 1. Chemical means and appearance parameters for fresh ground sausage

Types of coarse fresh sausage	N	Producers	Moisture (%)	Fat (%)	Total protein (%)	Moisture protein ratio (MPR)	Collagenous connective tissue (%)	Collag. con. tissue per total protein (%)	Appearance evaluation		
									Connective tissue amount*	Fat amount*	Value ** (1-5)
Not characterized sausage	1	A	55.0 (0.6)	31.4 (1.9)	12.3 (0.7)	4.5	2.6 (0.5)	21.1	-	-	-
	2	A	52.0 (0.1)	33.4 (1.1)	12.1 (0.2)	4.3	2.3 (0.2)	19.0	R	R	2
	3	A	70.4 (0.5)	11.6 (0.2)	13.8 (0.1)	5.1	2.0 (0.3)	14.5	S	S	4
	4	A	71.1 (0.5)	9.3 (0.5)	14.7 (1.6)	4.8	1.5 (0.1)	10.2	S	S	4
	5	A	44.7 (0.2)	42.4 (0.3)	9.0 (0.1)	5.0	3.3 (0.3)	36.7	M	M	1
	6	B	65.0 (0.9)	17.2 (0.7)	15.4 (0.8)	4.2	5.4 (1.0)	35.1	M	R	1
	7	C	49.2 (0.3)	39.5 (1.4)	9.9 (0.8)	5.0	3.0 (0.5)	30.3	M	M	1
	8	D	65.9 (0.4)	13.2 (0.2)	16.8 (0.1)	3.9	1.2 (0.1)	7.1	S	S	4
	9	E	57.5 (0.4)	24.6 (0.0)	12.0 (0.3)	4.8	1.5 (0.0)	12.5	S	M	3
	10	F	66.2 (0.5)	16.8 (0.7)	13.9 (1.8)	4.8	2.5 (0.1)	18.0	R	R	3
	11	F	60.6 (1.0)	18.8 (0.5)	15.0 (0.1)	4.0	1.2 (0.1)	8.0	S	R	4
	12	G	57.2 (0.1)	24.4 (0.9)	12.3 (0.6)	4.7	3.4 (0.3)	27.6	R	R	3
	13	H	57.8 (0.1)	25.7 (0.5)	12.1 (0.0)	4.8	1.5 (0.2)	12.4	R	R	3
	14	H	61.5 (0.2)	22.8 (0.4)	12.8 (0.4)	4.8	1.5 (0.2)	11.7	R	R	3
	15	I	63.5 (0.3)	19.1 (0.6)	12.4 (0.3)	5.1	1.3 (0.1)	10.5	S	R	3
	16	J	52.4 (0.5)	27.8 (1.3)	17.8 (1.3)	2.9	2.2 (0.1)	12.4	R	R	3
	17	K	56.3 (0.1)	26.1 (0.0)	10.8 (0.0)	5.2	4.3 (0.2)	39.8	M	M	1
	18	L	56.8 (0.0)	28.1 (0.4)	11.2 (0.1)	5.1	1.8 (0.1)	16.1	R	R	2
	19	L	49.1 (0.5)	32.8 (0.4)	11.7 (0.1)	4.2	1.7 (0.1)	14.5	R	M	2
	20	M	55.5 (1.4)	26.4 (1.4)	11.5 (1.3)	4.8	2.8 (0.0)	24.3	M	R	2
Tuscan type sausage	21	D	65.0 (0.1)	14.4 (0.1)	17.3 (0.0)	3.8	1.5 (0.0)	8.7	S	S	4
	22	D	64.7 (0.3)	15.6 (0.9)	16.0 (0.1)	4.0	1.2 (0.0)	7.5	S	S	4
	23	D	67.4 (0.4)	11.0 (0.9)	16.2 (0.3)	4.2	0.7 (0.0)	4.3	S	S	4
	24	G	63.4 (0.1)	19.1 (2.2)	12.6 (0.5)	5.0	2.4 (0.1)	19.0	R	R	3
	25	G	57.4 (0.3)	26.8 (1.3)	11.6 (0.2)	4.9	1.8 (0.0)	15.5	R	R	3
	26	N	63.1 (0.0)	19.3 (1.0)	13.0 (0.1)	4.9	2.4 (0.2)	18.5	R	R	3
	27	N	58.8 (0.5)	27.6 (0.5)	13.4 (0.4)	4.4	2.6 (0.2)	19.4	R	R	3
	28	N	55.9 (0.2)	29.2 (0.9)	10.8 (0.1)	5.2	2.6 (0.1)	24.1	S	R	3
	29	O	49.7 (0.5)	34.8 (0.3)	11.4 (1.4)	4.4	1.7 (0.2)	14.9	S	M	2
	30	P	58.0 (0.3)	23.8 (1.3)	12.5 (0.6)	4.6	2.2 (0.1)	17.6	R	R	3
	31	P	58.7 (0.2)	20.0 (1.5)	11.8 (0.3)	5.0	2.2 (0.2)	18.6	M	S	2
	32	Q	65.4 (1.7)	15.7 (0.1)	16.0 (0.1)	4.1	1.8 (0.0)	11.3	S	S	5
	33	R	45.8 (0.2)	34.2 (2.2)	11.0 (0.9)	4.2	3.9 (0.3)	35.5	M	M	1
	34	S	58.0 (0.6)	26.7 (0.0)	9.8 (1.0)	5.9	1.5 (0.1)	15.3	S	R	3
	35	T	53.5 (0.5)	29.9 (0.5)	10.9 (0.4)	4.9	1.4 (0.3)	12.8	-	-	-
	36	U	58.7 (0.3)	25.1 (0.3)	10.8 (0.8)	5.4	1.9 (0.2)	17.6	R	R	3
Calabrian type sausage	37	O	68.3 (0.1)	8.9 (0.1)	17.7 (0.1)	3.9	1.1 (0.0)	6.2	S	S	5
	38	P	62.2 (0.1)	23.3 (0.2)	11.0 (0.1)	5.7	1.9 (0.1)	17.3	S	R	4
	39	P	60.9 (0.0)	22.0 (0.4)	12.5 (0.2)	4.9	0.8 (0.1)	6.4	R	R	2
	40	V	62.1 (0.6)	16.8 (1.3)	14.6 (0.4)	4.3	1.4 (0.2)	9.6	R	S	4
	41	W	57.1 (0.3)	25.3 (0.1)	10.8 (0.5)	5.3	2.3 (0.1)	21.3	R	R	2
Beef and pork mixed sausage	42	X	61.2 (0.3)	24.1 (0.2)	11.4 (0.1)	5.4	2.4 (0.1)	21.1	R	R	3
	43	Y	59.8 (0.5)	23.5 (0.9)	12.2 (0.4)	4.9	2.2 (0.6)	18.0	S	R	4
	44	AD	43.4 (1.3)	46.1 (1.5)	8.4 (0.1)	5.2	3.1 (0.4)	36.9	M	M	1
Pork sausage	45	A	70.5 (0.3)	11.9 (0.3)	13.7 (0.4)	5.1	2.2 (0.3)	16.1	S	R	3
	46	L	55.6 (0.2)	29.1 (0.5)	10.6 (0.1)	5.2	1.6 (0.1)	15.1	S	M	3
	47	X	72.6 (0.2)	6.4 (0.0)	18.5 (0.2)	3.9	1.2 (0.0)	6.5	S	S	5
	48	Y	67.8 (0.2)	17.0 (0.0)	11.5 (0.3)	5.9	1.5 (0.2)	13.0	S	R	3
	49	Z	59.6 (0.1)	21.1 (0.4)	16.4 (0.1)	3.6	1.3 (0.4)	7.9	S	R	4
	50	AB	54.0 (0.5)	31.1 (0.4)	10.6 (0.3)	5.1	1.6 (0.3)	15.1	R	M	2
	51	AC	50.0 (0.2)	33.4 (1.1)	10.7 (0.2)	4.7	2.3 (0.2)	21.5	R	M	3
	52	P	71.3 (0.1)	11.7 (0.0)	13.0 (0.0)	5.5	1.4 (0.0)	10.8	S	S	5
Poultry sausage	53	N	65.6 (0.3)	15.6 (0.2)	16.2 (0.5)	4.0	2.5 (0.4)	15.4	S	R	4
	54	S	74.3 (0.2)	2.7 (0.1)	17.2 (2.1)	4.3	0.9 (0.1)	5.2	S	S	5
	55	Y	66.7 (0.1)	16.5 (0.1)	13.0 (0.4)	5.1	1.8 (0.1)	13.8	S	R	4
Min. value			43.4	2.7	8.4	2.9	0.7	4.3			
Max. value			74.3	46.1	18.5	5.9	5.4	39.8			
Median			59.7	23.4	12.4	4.8	1.8	15.2			
Average			60.0	22.6	13.0	4.7	2.0	16.6			
S.D.			7.2	9.0	2.4	0.6	0.9	8.5			
C.V. (%)			12	40	19	13	43	51			

*Connective tissue and fat amounts: S= slight R=regular M=much
SD= standard deviation C.V.= coefficient of variation

**Overall acceptability value: 1=worst; 2=bad; 3=regular; 4=good; 5=very good