

CHEMICAL COMPOSITION AND COLLAGENOUS CONNECTIVE TISSUE EVALUATION OF COMMERCIAL FRANKFURTER-TYPE SAUSAGES

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Background

In finely comminuted sausages like frankfurters (hot dogs, wieners), meat protein and water are combined to form a matrix that encapsulates fat, thus forming an emulsion. Basically, a meat emulsion is a semi-fluid mass with fat particles held or suspended by meat protein and water. Curing ingredients contribute to flavor, color and preservation. The finished products may not contain more than 65% moisture, 30% fat (frankfurters, wieners, hot dogs) or 35% fat (frankfurter-type or wiener-type), but at least 12% protein (BRASIL, 2000). The same emulsion-type sausage regulation allows 4% non-meat protein, of either vegetable or animal source, as added protein, which are nevertheless not allowed in frankfurter and wiener (except for milk proteins). It is also permitted the addition (isolated or in combination) of up to 10% of skin, rind, tendon, bone marrow and offal such as brain, liver, heart, tripe, tongue, kidney, most of them, collagen-rich by products (except for frankfurter and wiener). Connective tissues are largely added to reduce meat product's costs. According to SIMS and BAILEY (1981), collagen exhibits a characteristic amino acid analysis result, the most noticeable feature being a high glycine and pyrrolidine content, which together comprehend approximately half of the total amino acids. The presence of the amino acid hydroxyproline in collagen (about 14%) is also a unique feature because this amino acid occurs in only a few other proteins – namely elastin (1.6%), to a lesser extent in the serum complement protein, and in certain plant proteins. Elastin is a highly insoluble fibrous protein and, as such, very difficult to isolate and purify. Elastin contributes with only about 0.5% to the overall connective tissue content of muscle, and most of it distributed within the blood vessels (tissue requiring a high degree of elasticity and recovery from deformation). A few muscles contain a high proportion of elastin, for example M. semitendinosus where elastin constitutes about 37% of the whole connective tissue. According to SADLER & YOUNG, (1993), increasing replacement of lean tissue by fibrous form of connective tissue, tendon, resulted in an increasing loss of favorable texture, flavour and overall acceptability. The biological value of collagenous connective tissue is limited because of its low amino acid balance, being low in methionine and devoided of tryptophan. Adults and children consume significant amounts of processed meat products (including sausages), often using them as substitutes for meat flesh. Therefore, it is important to maintain the nutritional profile of these products.

Objectives

Evaluate chemical composition and content of collagenous connective tissue from 4-hydroxyproline amount in commercial frankfurter-type sausages. Offer helpful informations contributing to legislation standards.

Methods

Forty-eight cooked emulsion-type sausages (31 not characterized sausage, 9 hot dogs, 3 junior sausages, 4 chicken sausages and 1 wiener type sausage) from 26 different producers were chemically analysed in Adolfo Lutz Institute during the period of 2000 – 2002. The samples were finely chopped, mixed thoroughly and analysed in duplicate to determine their chemical composition. Moisture (oven at 102-105°C), protein (Kjeldahl method, factor 6.25) and fat (diethyl ether extractable) contents were determined according to INSTITUTO ADOLFO LUTZ (1985) procedures. Hydroxyproline assay was carried out according to the method described by AOAC (1995). Hydroxyproline was quantitatively determined, in order to measure collagenous material. Samples were hydrolyzed with 6N HCl for 8h at 110°C. After hydrolysis, 4-hydroxyproline was converted to pyrrole with chloramine T in acetate-citrate buffer pH 6.0, and pyrrole was converted to a red-coloured complex (absorption at 558nm) by reaction with Ehrlich reagent [p-(dimethylamino)benzaldehyde in perchloric acid/2-propanol]. Total connective tissue proteins were determined by multiplying hydroxyproline contents by 8.

Results and Discussion

In Table 1, results showed that values for moisture ranged from 51.7 to 66.2% (only 1 product contained over 65% - legal limit). Fat content ranged from 9.3 to 27.9% (none over 30% and 35%), protein means, 5.4 to 15.7% (17 results below the minimum of 12%). Moisture-protein ratio (MPR) ranged from 3.8 to 11.5. Collagenous connective tissue (CCT) ranged from 0.7 to 3.1% and calculated collagenous connective tissue per total protein (CCT/P), 5.3 to 27.1%. Median and average results for emulsion type sausages stood very close to each other and revealed moisture values of 59.8% and 59.4%, fat, 18.3% both, total protein, 12.7% and 12.4%, MPR, 4.6 and 5.0, CCT, 1.7% and 1.8%, CCT/P, 13.5% and 14.7%. Coefficients of variation (C.V.) ranged from 5% for moisture to 34% for CCT. Great results variability was observed for fat, moisture protein ratio and collagenous connective tissue contents (CCP and CCP/P – Figure 1). Most samples of hot-dog type sausage, usually consumed in school lunches and in children hospitals are sent to Adolfo Lutz Institute for analysis; with a record of unsatisfactory sensory characteristics, specially concerning flavor acceptance by the consumers. Once a good meat product flavor stays intrinsically connected to non-collagenous myofibrillar proteins, it is convenient to limit maximum connective tissue proteins content in meat products allowed.

Conclusions

Commercial emulsion type sausages showed a great chemical composition variability, mainly for fat and collagenous connective tissue proteins contents. Results showed that minimum protein limit for these products were not obeyed for 35% of products analyzed. To assist in sensory problems with frankfurter-type sausages, regulation standards for maximum collagenous connective tissue content should be established.

References

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Table 1. Chemical parameters means for commercial emulsion type sausages

Emulsion type sausages	N	Producers	Moisture (%)	Fat (%)	Total protein (%)	Moisture-protein ratio (MPR)	Collagenous connective tissue (%)	Coll. con. tissue per total protein (%)
Not characterized sausage	1	A	62.9 (0.1)	16.3 (1.0)	13.3 (0.4)	4.7	3.1 (0.1)	23.3
	2	A	61.1 (0.1)	18.1 (0.1)	12.1 (0.1)	5.0	2.5 (0.0)	20.7
	3	B	60.0 (0.0)	16.3 (0.1)	9.2 (0.0)	6.5	1.5 (0.1)	16.3
	4	C	55.4 (0.3)	23.3 (0.4)	13.3 (0.0)	4.2	1.4 (0.1)	10.5
	5	D	58.0 (0.3)	24.2 (0.1)	11.5 (0.1)	5.0	1.3 (0.0)	11.3
	6	D	51.7 (0.2)	27.9 (0.3)	12.3 (0.0)	4.2	1.3 (0.1)	10.6
	7	E	57.5 (0.1)	20.8 (0.0)	13.7 (0.0)	4.2	1.8 (0.0)	13.1
	8	F	58.1 (0.3)	19.1 (0.5)	11.2 (0.1)	5.2	1.6 (0.0)	14.3
	9	G	60.1 (0.2)	17.9 (0.2)	14.6 (0.1)	4.1	2.9 (0.0)	19.9
	10	H	58.2 (0.0)	18.9 (0.1)	14.0 (0.1)	4.2	2.7 (0.0)	19.3
	11	H	60.1 (0.0)	20.9 (0.2)	11.5 (0.4)	5.2	2.6 (0.0)	22.5
	12	K	64.9 (0.0)	13.7 (0.0)	15.1 (1.8)	4.3	1.8 (0.0)	11.9
	13	L	60.4 (0.0)	17.1 (0.1)	13.4 (0.1)	4.5	2.5 (0.0)	18.7
	14	L	59.9 (0.1)	15.1 (0.1)	13.3 (0.0)	4.5	2.5 (0.2)	18.9
	15	M	56.3 (0.2)	22.9 (0.6)	14.3 (0.1)	3.9	1.8 (0.0)	12.3
	16	M	58.2 (0.0)	18.4 (0.1)	15.0 (0.1)	3.9	1.9 (0.1)	12.5
	17	M	57.5 (0.0)	21.2 (0.1)	13.0 (0.4)	4.4	1.5 (0.1)	11.5
	18	N	62.3 (0.1)	14.8 (0.0)	5.4 (0.2)	11.5	1.4 (0.0)	27.1
	19	P	58.3 (0.0)	17.8 (0.1)	12.2 (0.2)	4.8	1.6 (0.1)	13.1
	20	Q	58.6 (0.3)	16.9 (0.1)	9.7 (0.0)	6.0	1.6 (0.1)	16.5
	21	Q	56.0 (0.1)	17.0 (0.1)	10.3 (0.1)	5.4	1.9 (0.0)	18.2
	22	R	56.2 (0.0)	18.3 (0.0)	10.8 (0.0)	5.2	1.5 (0.0)	13.9
	23	S	58.6 (0.0)	17.8 (0.1)	11.0 (0.1)	5.3	1.0 (0.0)	9.1
	24	T	60.5 (0.2)	18.6 (0.2)	13.3 (0.0)	4.5	1.7 (0.0)	12.8
	25	U	57.3 (0.0)	21.6 (0.3)	12.9 (0.1)	4.4	2.9 (0.0)	22.5
	26	V	53.7 (0.0)	22.5 (0.2)	14.2 (0.1)	3.8	2.6 (0.0)	18.6
	27	W	64.1 (0.0)	9.3 (1.5)	9.3 (0.1)	6.9	1.4 (0.1)	15.4
	28	X	62.9 (0.1)	13.7 (0.2)	15.7 (0.4)	4.0	1.3 (0.0)	8.6
	29	X	60.7 (0.1)	15.0 (0.2)	14.9 (0.1)	4.1	1.3 (0.0)	8.7
	30	Y	60.1 (0.1)	18.2 (0.2)	13.4 (0.8)	4.5	1.9 (0.0)	14.2
	31	Z	58.0 (0.1)	14.8 (0.1)	10.4 (0.0)	5.6	0.9 (0.0)	8.7
Hot Dog	32	D	55.0 (0.3)	23.1 (0.2)	13.1 (0.2)	4.2	2.2 (0.0)	16.8
	33	D	57.2 (0.1)	21.8 (0.2)	12.3 (0.1)	4.7	1.3 (0.0)	10.6
	34	H	62.6 (0.0)	18.6 (0.1)	11.9 (0.1)	5.3	2.1 (0.2)	17.7
	35	H	60.8 (0.3)	21.1 (0.0)	10.9 (0.1)	5.6	2.4 (0.0)	22.0
	36	I	64.3 (0.1)	15.3 (0.1)	13.3 (0.3)	4.8	1.4 (0.0)	10.3
	37	I	66.2 (0.0)	13.4 (0.0)	12.2 (0.6)	5.4	1.2 (0.0)	9.7
	38	I	59.6 (0.2)	18.6 (0.1)	13.8 (0.1)	4.3	2.5 (0.1)	18.1
	39	O	57.9 (0.2)	13.6 (0.2)	8.0 (0.1)	7.2	1.0 (0.1)	12.5
	40	S	58.3 (0.1)	18.8 (0.2)	11.4 (0.0)	5.1	1.0 (0.0)	8.8
Junior sausage	41	D	61.2 (0.1)	19.0 (0.1)	13.3 (0.1)	4.6	0.7 (0.0)	5.3
	42	E	61.0 (0.1)	17.4 (0.0)	13.2 (0.0)	4.6	2.6 (0.0)	19.7
	43	I	58.7 (0.1)	18.3 (0.1)	14.9 (0.0)	3.9	1.4 (0.0)	9.4
Chicken sausage	44	A	61.1 (0.1)	13.1 (0.2)	12.4 (0.2)	4.9	2.2 (0.1)	17.7
	45	C	54.8 (0.4)	26.6 (0.2)	12.5 (0.0)	4.4	2.3 (0.0)	18.4
	46	J	61.0 (0.5)	16.2 (0.4)	11.4 (0.0)	5.4	1.1 (0.1)	9.6
	47	J	61.3 (0.3)	20.0 (0.0)	10.9 (0.1)	5.6	1.3 (0.2)	11.7
Wiener type sausage	48	I	61.0 (0.0)	17.3 (0.0)	14.6 (0.0)	4.2	1.7 (0.0)	11.6
Minimum value			51.7	9.3	5.4	3.8	0.7	5.3
Maximum value			66.2	27.9	15.7	11.5	3.1	27.1
Median			59.8	18.3	12.7	4.6	1.7	13.5
Average			59.4	18.3	12.4	5.0	1.8	14.7
S.D.			2.9	3.6	2.0	1.2	0.6	4.8
C.V. (%)			5	20	16	25	34	33

S.D. = Standard deviation

C.V.= Coefficient of variation

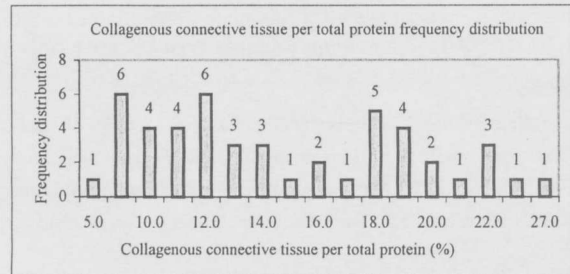
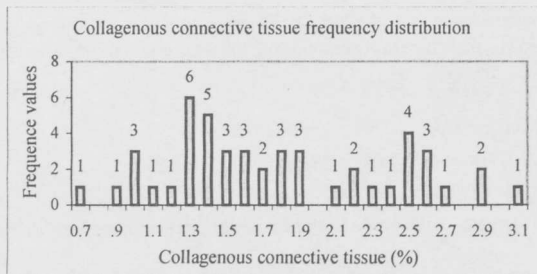


Figure1. Collagenous connective tissue frequency distribution for commercial emulsion type sausages