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INFLUENCE OF SOME ADDITIVES ON THE QUALITY OF COOKED, EMULSION-TYPE BEEF SAUSAGE AND CANNED PRODUCTS

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Cooked, emulsion-type sausage was prepared from 50% lean beef, 33% beef fat tissues and 17% ice. The effects of several additives on the characteristics of the cooked product were examined. The additives included 0.3% sodium diphosphate, 2% soy protein isolate (SPI) emulsion, 2% dry SPI, 2% sodium caseinate (SC) emulsion, 2% dry SC and 2% modified starch (MS). A portion of each batch was canned at 121°C for 90 min. Sodium diphosphate and starch enhanced the absorption of separated fluids during canning when canned products were stored at 37°C for 7 days and no swelling or changes in the overall acceptability occurred during storage. Best treatment was the sodium diphosphate which also had highest organoleptic scores and markedly high red colour intensity when sausages were prepared with other additives. Sausages prepared with dry SPI and SC were acceptable and given higher organoleptic scores than those prepared with SPI and SC emulsions. The lowest organoleptic scores were given for the control sample. The present work was conducted to improve the binding ability, tenderness and texture of cooked, emulsion type sausage. The effect of some common sausages and production of high quality beef sausages and canned products were also studied.

Key words: Emulsion type-sausages, Additives, Canned products.

Introduction

Sausages are often products of local preference [1]. Many current sausage recipes are not acceptable in Muslim countries because the lard (Pig pork), one of the chief components of cooked emulsion sausages, is religiously prohibited for Muslims and is also not available in the local market. In addition, in those countries, to save refrigeration energy, cooked sausage might be more suitable than fresh one. Wagner [2] reported that phosphates may be used as potential substitute for currently used nitrite in cured meat products. Moreover phosphates improve tenderness and moisture retention, reduce shrinking during cooking and enhance fat emulsification. Also under certain conditions, phosphates enhance the microbial safety and stability of foods [3]. As reported by Mullins and Buckley [4], sodium caseinate and soy protein isolate (SPI) are considered to be the most suitable additives for emulsion manufacture. According to Abd-el-Bake [5] and Shehata *et al.* [6] soy protein have better water holding capacity (WHC), plasticity and soy protein products exert an antioxidant effect. Decker *et al.* [7] found that use of lean meat to reduce fat content resulted in darker and tougher frankfurters while replacing 22.3% meat with hydrated SPI (reversed the negative effect of the increase lean meat, since the high degree of SPI hydration) improved the juiciness of low-fat frankfurters. Therefore, SPI was useful in preparing low-fat sausages of eating quality similar to that of controls. Savchenco *et al.* [8] showed that the incorporation of sodium caseinate at the 3% level in cooked sausages had deleterious effects on both the organoleptic properties and the nutritional values whereas SPI had beneficial effects. According to Sokolov [9] addition of starch was found to improve the water binding ability of emulsions especially when they were heated.

Materials and Methods

Processing. Lean meat (RII grade, 65% moisture, 22% protein, 4% connective tissues, 8% fat [10, 11] and beef fat tissues were used in this study. After trimming, the meat was cooled (at + 2°C), then lean meat and fat tissues were ground (model WD 114, Seydlmann KG, F.R. Germany) separately through a 3mm plate. Further comminution and mixing (chopping) was carried out in a cutter (20 Ltr. Muller GmbH, Germany). Lean meat was chopped first with curing nitrite salt (NPS 0.4 Na NO_2 + 99.6% NaCl, [12] and sodium diphosphate at low speed for about 2 min, then half of ice was added (about 2 min rotations). After the ice has been absorbed by the meat (meat pulp), the beef fat, emulsion (if used in recipe) spices, other additives and the rest of ice were added in the given order (for further about 5 min) to a final temperature of 14-16°C. The finished paste was discharged directly to a piston-type Stuffer (F20-Top Hadtmann GmbH, F.R. Germany) for filling either in tin plate cans (diameter 99mm, height 40mm) or artificial casings, 90mm in diameter (Naturin Werke-Becker, Germany). The cans were sterilized in an agitating retort (Korimat KA 240/25 Wagner, Germany) at 121°C for 90 min to an Fo-value of 5.5. Sausages were cooked to an internal temperature of 68°C in a steam heated universal chamber at 75°C for about 2 hrs. After heating, sausages were

cooled in water (about 10 min) hang, for about 15 min., to obtain a dry surface and packaged in polyethylene bags.

Treatments. The recipe of cooked emulsion type sausages were as follows:-

(i) Control without traditional additives: Lean beef 50%, Beef fat tissues 33%, Ice 17%.

The total quantity of ice included the quantities of curing agents, spices and additives in the treatments ii-vii.

Curing agents and powdered spices were as follows (gm/kg lean meat + fat tissues):

Nitrite curing salt (NCS)	22.0gm	Sodium ascorbate	0.5 gm
Dextrose	2.0 gm	Lactose	5.0 gm
Black pepper	3.0 mg	Paprika	2.0 gm
Caraway	1.0 gm	Coriander	1.0 gm
Garlic powder	0.5 gm	Mustard powder	0.5 gm
Monosodium glutamate	0.5 gm		

(ii) Formula as (i) but 0.3% sodium diphosphate (El dophos, Hagesued Interspice Grewuerz werke-Stuttgart, Germany) was added.

(iii) Formula as (i) but with a soyprotein isolate emulsion (SPI 90% protein, unifood condimenta. Stuttgart, Germany), prepared with 1 part SPI plus 5 parts of water and 5 parts of fat tissues. Beef fat was chopped to a creamy consistency, then hot water (80°C) was added and after some rotations of bowl, the SPI (2% of meat + fat tissues) were added. The finished emulsion could be stored for about 24 hrs at 2°C.

(iv) Formula as (iii) but SPI was added dry at the concentration of 2% lean meat and fat.

(v) Formula as (iii) but instead of SPI 2% sodium caseinate (Bindefix, Grewurz Mueller, F.R. Germany) was added.

(vi) Formula as (v) but sodium caseinate (SC) was added as a dry powder.

(vii) Modified starch at the concentration of 2% (Mondamin Knorr Caterplan, F.R. Germany) was used.

Analytical methods. The product was analysed for the following components: moisture and protein content [13] ash [14], fat [15], NaCl [16], NO_2 (as $NaNO_2$), NO_3 (as KNO_3), total NO_2 and starch contents [17]. The connective tissue protein was determined according to Sommer [18] by photometric analysis of hydroxy-L-proline. Total jelly (separated fat and jelly in cans) was determined according to Hoffmann [19]. The colour was measured using Tricolour LFM3 instrument (Duesseledorf-F.R.Germany) by determining the L^*,a^*, b^*, values. A circular slice, 5mm thick (40mm diameter) of the meat product was cut from each sausage and placed in the instrument cuvette. After adding a special washer, the cuvette was transferred to the measuring instrument [20]. The water activity was determined using a humidity measuring instrument (Thermo constanter, Type Novasina) according to the method of Rodel *et al.* [21]. Texture indices, protein water coefficient (PWC =%protein /% moisture) and protein: water fat coefficient (PWFC =%protein /% moisture +% fat) were calculated according to Tsuladze [22]. For consistency measurement a Warner Bratzler Type shear force was made with the Instron food testing instrument (Model 1140, Instron Limited) combined with the recorder system E1ARM 3000 (Industric Electronic Muenchen), the shear force was measured by a load all with a compression load range from 50 to 500 neutons.

Organoleptic evaluation. The quality characteristic of the cooked emulsion-type beef sausages and canned products were evaluated by 21 panelists selected from employees of the Ismailia Slaughterhouses (Meatland, Egypt). Samples were also perceived by using a modified five point rating scale according to the method of Jellinek [23] published in the organoleptic evaluation of meat products in West Germany.

Statistical analysis. Results of organoleptic evaulation of cooked, emulsion-type sausage and canned products were analyzed statistically using the complete randomized block method of Snedecor and Cochran [24].

Results and Discussion

Analysis of raw lean beef and beef. According to the results obtained, the best cuts of meat used were lean beef of the shoulder (grade II beef), the same record were achieved by Reuter [10] and Shehata [11]. The values were given about the chemical composition as the moisture, protein, fat and ash contents for both lean beef meat and beef fat tissues. Percantages were 69. 05, 7.39, 20.97, 1.77, 9.03, 90.50, 0.95 and 0.08% respectively. Actually this meat was typical grade II beef lean meat which might be less tender than the fat tissues as indicated by its higher PWC and PWFC values for lean beef meat and beef fat tissues. Percentages were 0.3037, 0.2395, 0.2686 and 0.0181% respectively [20].

Chemical composition of sausages. As shown in Table 1, sausages with sodium diphosphate had the highest moisture content (57.68%). Soy protein isolate (SPI) sausages had slightly higher moisture content than the sodium caseinate (SC) sausages, and the difference was more pronounced when these additives were added as emulsion than as the dry powder. Sodium diphosphate and SPI samples had relatively higher moisture contents while SC and starch samples showed lower moisture contents compared with the controls [6]. Controls had the highest fat content followed by sausages treated with SC and starch treatment while lower fat content was recorded for sodium diphosphate and SPI sausages. The protein content was the highest in sausages with dry SPI (14.28%)

TABLE 1. WATER ACTIVITY (^{a}w), CONTENTS OF MOISTURE PROTEIN, FAT, ASH AND CONNECTIVE TISSUES OF COOKED EMULSION TYPE SAUSAGES STUFFED IN POLYETHYLENE CASINGS AND TOTAL JELLY VALUES FOR CANNED PRODUCTS.

Treatments	Water activity ^{a}w value	Moisture %	Protein %	Fat %	Ash %	Moisture to protein ratio	Connective tissue %	Total jelly in canned products %
1	0.956	56.0	12.52	29.00	2.34	4.5	4.28	14.91
2	0.974	57.68	13.18	26.48	2.57	4.4	4.18	4.70
3	0.971	56.28	13.80	26.91	2.29	4.1	3.95	22.78
4	0.957	56.00	14.28	27.09	2.35	3.9	3.84	11.63
5	0.955	55.31	13.74	28.00	2.31	4.0	4.28	9.31
6	0.950	55.16	14.03	28.37	2.39	3.9	4.17	13.68
7	0.956	55.98	11.87	28.99	2.33	4.7	4.25	7.13

Treatment: (1). Control sample (without traditional additives). (2). 0.3% Sodium diphosphate. (3). 2% SPI emulsion. (4). 2% dry SPE. (5). 2% SC emulsion. (6) .2% dry SC. (7) .2% modified starch (M.S).

TABLE 2. CONTENTS OF NO_2, NO_3, TOTAL NO_2, NaCl AND STARCH (FOR STARCH TREATMENT ONLY).

Com-pounds	NO_2 $NaNO_2$	NO_3 as KNO_3 ppm	Total NO_2 as $NaNO_2$ ppm	NaCl %	Starch (for starch treatment only) %
Average value	25.56	33.64	48.40	1.90	1.76

and lowest in those with starch (11.87%) and controls (12.52%). The highest ash content was found in the sodium diphosphate sausages while it was lowest in sausages with SPI emulsion. For the canned products, only total jelly was determined (Table 1). Sodium diphosphate followed by starch, seemed to be efficient in enhancing the separated fluids absorption by the canned meat mixture (total jelly was 4.70 and 7.13% respectively). In this connection SPI emulsion treatment showed the highest amount of total jelly (22.78%) which was higher for SPI than SC sausages. Starch seemed to enhance the absorption of fluids by sausages as indicated by its higher moisture to protein ratio (4.7) compared with the sodium diphosphate treatment (4.4) or other treatments (3.9.-4.5). Heating has been found to improve water absorption ability of starch considerably [25]. Connective tissue protein seems to have relation to the water absorption and water activity ^{a}w of samples.

Gailani and Fung [26] reported that higher the moisture content, the higher is the water activity ^{a}w. For treatments i-iv, the moisture content range was 56.00-57.68% and ^{a}w 0.956-0.974 while for treatments v-vii, the moisture content was lower, i.e. 55.16-55.98%, and ^{a}w 0.950-0.956. NaCl content (Tables 1 & 2) seems to have no influence on proximate chemical composition because its concentration was nearly the same for all treatments. The total nitrite (Table 2, 48.40 ppm) was markedly less than the permitted amount given by Egyptian Standard (1991, 125 ppm)[27]. The NaCl concentration (Table 2,1.90%), moisture content (Table 1,5 5.31-57.68) and fat content (26.48-29.00%) were also less than the permitted level by the Egyptian Standard [27] (NaCl not more than 3% fat not more than 30%, and moisture content not more than 60%).

Conclusion

From the results presented in Table 3, it can be seen that the best treatment was with sodium diphosphate which showed highest average organoleptic scores (46.4), best consistency

TABLE 3. COLOUR (L*, a*, b*), CONSISTENCY (WARNER BRATZLER SHEAR FORCE) AND ORGANOLEPTIC EVALUATION OF COOKED EMULSION TYPE SAUSAGES.

Treatment	Colour			Consistency	Organoleptic evaluation (average total score)*		Grade for both sausages and canned products
	L*(Brightness)	a*(Red)	b*(Yellow)	X	Sausages	Canned product	
1	44.77	8.44	8.92	22.17	32.4c	35.8d	6
2	45.10	9.46	9.01	18.65	46.4c	47.1a	1
3	40.60	8.62	9.33	22.16	29.6c	33.4d	7
4	44.78	8.98	8.95	20.09	37.0b	39.0c	4
5	45.24	8.69	9.23	22.10	35.4b	37.6c	5
6	43.23	9.04	8.63	25.10	39.6b	42.0b	2
7	43.15	9.58	8.59	24.76	37.8b	40.2b	3

Treatment: (1). Control sample (without traditional additives). (2). 0.3% Sodium diphosphat. (3) .2% SPI emulsion. (4) .2% dry SPE. (5). 2 % SC emulsion. (6). 2% dry SC. (7). 2% modified starch (M.S.). *Means with different letters in the same column indicate significant difference at 5% level.

(18.65) high brightness and highest red colour intensity. While the sausages prepared with dry SPI or SC were acceptable, the samples prepared with their emulsions showed lower organoleptic scores. The lowest organoleptic scores were found for the control samples. The modified starch (MS) samples had relatively higher orangoleptic scores (Table 3) than were suitable due to their low protein content (Table 1, 11.87%). The canned products were actually of extraordinary appearance, when stored at 37°C for 7 days no swelling or change in taste, aroma or colour were noticed. Products treated with sodium diphosphate, both sausages and canned, were the best organoleptically (Table 3). However, low intensity of spice flavour and low salt taste were noticed in these as well as in other treatments. Therefore, further study is suggested to improve the quality of products investigated in this study so as to fulfill the following objectives: (1)Increase in spice and salt contents (2) using dry SPI and SC in formula with low levels of fat, (3) improving the emulsion quality through decreasing SPI and SC in the emulsion and (4) production of beef sausages with low fat level.

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