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PREPARATION AND EVALUATION OF DIFFERENT TYPES OF SAUCE FORTIFIED WITH SOME PROCESSED MEAT PRODUCTS

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ABSTRACT

Sauce (salsa) products containing 40% of a meat ingredient (chicken or beef-sausage or pastrami) in combination with sour cream, yoghurt, tofu, potassium sorbate and carrageenan were developed . They were produced to be consumed with fried potatoes in order to obtain a balanced meal. Beef sauce was the highest in moisture and fat. Pastrami salsa was the highest in protein. After 3 weeks of storage (4°C), beef sauce demonstrated the highest growth rate of lactic acid bacteria (LAB) and had the lowest pH value (4.4); while pastrami salsa demonstrated the lowest growth rate of LAB and had the highest pH value (5.6). The three sauce products had a shelf – life of 3 weeks in the refrigerator (4°C). Thiobarbituric acid, total volatile nitrogen and total plate count were all within the allowed limits. No significant organoleptical differences were found among the sauce products. Hence, the three types of sauce were recommended to be manufactured commercially.

Key words: *meat constituents, sauce (salsa)products, shelf life.*

1. INTRODUCTION

The snack product market has grown steadily in the past few years. Leveille (1988) reported that sales of corn-based snacks reached $ 1.6 billion in 1985, up from $ 1.1 billion in 1980, and the sales of potato chips increased from $ 1.9 billion to $ 3.3 billions in the same period.

Also increasing public interest in grain-based products will lead to additional demand in the future. It is well known that the consumption of an important group of cereal and potato snack products is often accompanied by that of adjuncts, particularly snack dips, i.e. sauce (salsa) products. Therefore, the development of salsa products formulated with meat products may offer a market with excellent growth potential for the meat industry.

Product safety is an important factor in the development of salsa products that is expected to lead to repeated and possibly severe exposure to temperature which brings to abuse by consumers. Although some cured meats are individually shelf-stable (i.e. Pastrami), their microbiological and chemical stability may be altered when combined with other ingredients such as dairy products and soy protein (Desrosier, 1984), often used to obtain certain characteristics. The inclusion of soy products, particularly tofu (a cheese-like soy protein curd precipitate), could provide the suggested new meat salsa products with desirable nutritional, textural and sensory characteristics (Rehberger *et al.*, 1984). Tofu contains all the essential amino acids, free of cholesterol and has a low ratio of calories to proteins, but it has also been reported to be high in bacterial contaminants (Dotson *et al.*, 1977; Rehberger *et al.*, 1984). Harrison *et al.*, (1983) found that mild acidification with organic or inorganic acids eliminated the reported acceleration of fresh, ground beef spoilage caused by extension of the meat with soy protein isolates. Therefore, yoghurt and sour cream were also included in the formulation of the meat sauce products in the present work. Goel *et al.*, (1971) and Arnolt *et al.*, (1974) reported that spoilage and pathogenic bacteria decreased rapidly in numbers when present in yoghurt and sour cream. Furthermore, in general, lactic acid-producing starter cultures used in dairy products are known to have an inhibitory effect on spoilage and pathogenic bacteria (Speck, 1976).

In addition, yoghurt has been reported to intensify the flavor and aroma of other ingredients (Steinberg, 1983).

There were two, objectives of this study: (1) To develop nutritious, palatable and safe sauce products formulated with a sizable proportion of meat products, (2) To evaluate these sauce products chemically, microbiologically, and organoleptically.

2. MATERIALS AND METHODS

2.1.Preliminary procedures and trials :

Three processed cured meat products were selected viz, chicken and beef sausages and pastrami. They were all prepared in the laboratory as shown in Table (1) for the sausages (Abd El-Aziz, 1990 & Sharaf, 2002).

Table (1): Composition of chicken or beef sausages *.

Ingredient	Quantity (g)
Chicken or beef meat	68.00
Sheep fat	15.00
Powdered milk	3.00
Sodium chloride	1.80
Sodium glutamate	0.10
Sodium nitrite	0.04
Ascorbic acid	0.03
Ground garlic	1.10
Spices	0.93
Water (ice flakes)	10.00

* The sausage was prepared by mincing the meat which was mixed with all ingredients (except fat) and half of the ice flakes. The mixture was blended for 2 min. in a chopper, then minced fat + remaining ice were added and mixed for 15 min. The final mixture was stuffed into mutton casing.

For the production of pastrami, a suitable beef intact muscle was chosen. Some holes were made in these muscles, and filled with a cure mixture of NaCl, sucrose and sodium nitrite. The rest of the cure mixture was rubbed on the muscle surface. The muscles received pressing and hanging processes followed by covering

with a coating of ground fenugreek, mashed garlic and hotless red pepper, followed by a final hanging process (Wahdan, 1996 and Osheba, 2003).

Several formulations were initially prepared for each of the three selected meat products using non-meat ingredients, *i.e.* sour cream, yoghurt and tofu. The first two ingredients were obtained from the Milk Technology Department and the latter was obtained from Soybean Technology Department, Food Technol. Res. Institute, Agric. Res. Center. Preliminary trials indicated that the meat flavors were enhanced by grinding the meat components to a paste which was supported by Defreitas and Molins, (1988). The final formula that was used in this study (Table, 2) was arrived at by gradual adjustment of the proportion of each ingredient so as to maximize that of the meat component, while retaining texture characteristics.

2.2. Preparation of meat sauce (salsa) products

The final sauce (salsa) formula is shown in Table (2). Each sauce product was prepared by cutting the meat components into small pieces (after boiling of sausages for 10 min and cooling them). The meat component was ground to a paste (in the presence of half of the sour cream) using a blender for one minute. The rest of the ingredients were added with the above ingredients and were blended together for 2 min. and were packaged in plastic containers.

Table (2): Final salsa formula.

Ingredient	Quantity (g)
Meat component *	40.00
Yoghurt	22.00
Tofu	10.00
Sour cream	27.80
Potassium sorbate	0.10
Carrageenan	0.10

* Meat components constituted of either chicken or meat sausages or pastrami. (15 ml of distilled water was added to each Kg of pastrami salsa to aid in the blending process).

Potassium sorbate was included to inhibit mold growth (Lunck, 1980; Liewen and Marth, 1985). In addition, carrageenan was included to improve the texture (Peckham and Freeland-Graves, 1979). Samples for zero-time analyses were used after preparation and the rest of the samples were stored in the refrigerator (4°C) for three weeks. Analyses were carried out every week.

2.3. Chemical determinations

Chemical composition (moisture, protein, fat and carbohydrates) was performed according to the method described in A.O.A.C. (1995). The pH value was measured according to the method described by Alken *et al.*, (1962).

2.4. Storage ability

Total volatile nitrogen (T.V.N.) content was determined using the method published by Winton and Winton (1958). Thiobarbituric acid value (T.B.A) was estimated according to Pearson (1970).

2.5. Microbiological analyses

These included total plate mesophilic count (T.P.M.C) and psychrophilic counts (Ps.C.). They were performed using Plate Count Agar with incubation at 37°C/48 hr and 4°C/10 days, respectively. Lactic acid bacteria (LAB) were enumerated using MRS agar with incubation at 30°C/72 hr. (Harold, 1967).

2.6. Sensory evaluation

It was carried out for all formulas of salsa products by covering potato chips (prepared and fried in the lab.) with equal amounts of the salsa. The organoleptic evaluation was performed according to Watts *et al.*, (1989), where the upper grade was 9.00.

Statistical analysis was carried out, and the following measures were calculated : standard deviation and least significant differences (L.S.D) at 5% probability were determind according to Snedecor and Cochran (1980).

3. RESULTS AND DISCUSSION

3.1. Chemical composition

Table (3) presents the chemical composition of the three sauce (salsa)products(chicken and beef sausages, and pastrami).Differences

between protein contents for the three salsa products are attributed to the type of meat component. Thus; pastrami, added as a low fat, low moisture-meat product, produced a salsa with the highest protein content.

Table (3): Chemical composition of the three sauce products at zero-time (% on wet and dry weight basis).

Constituents	Chicken-sausage sauce		Beef-sausage sauce		Pastrami sauce	
	W*	D**	W	D	W	D
Moisture	77.0	00.00	79.0	00.00	72.70	00.00
Protein	11.60	50.43	9.40	44.76	19.83	72.64
Fat	7.97	34.65	8.17	38.90	0.82	3.00
Ash	0.13	0.57	0.18	0.86	0.27	0.99
Carbohydrate	3.30	14.35	3.25	16.48	6.38	23.37

* W= Wet weight %
** D = Dry weight %

As expected, the beef salsa retained the highest moisture and fat contents, as the beef sausage had the highest moisture and fat contents compared to chicken sausage and pastrami (Table, 4). These results are supported by Abd El-Aziz (1990), Wahdan (1996) and Sharaf (2002).

Table (4): Chemical composition of chicken-sausage, beef-sausage and pastrami used for preparation of different types of sauce.

Constituents	Chicken-sausage		Beef-sausage		Pastrami	
	W *	D**	W	D	W	D
Moisture	62.38	00.00	64.41	00.00	49.05	00.00
Protein	15.25	40.54	11.46	32.20	33.52	65.79
Fat	18.35	48.78	20.43	57.40	2.37	4.65
Ash	2.80	7.44	1.95	5.48	4.36	8.56
Carbohydrate	1.22	3.24	1.75	4.92	8.55	16.78
Fiber	---		---		2.15	4.22

* W= Wet weight %
** D = Dry weight %

Concerning freshness tests, TBA values were low for all products at zero-time and up to 3 weeks of cold storage (Table, 5). These results indicate that the plastic containers used to store the salsa products did not allow oxygen passage, and so inhibited oxidative rancidity which kept TBA values low. These data are supported by those reported by Peckham and Freeland-Graves (1979).

Table (5): TBA and TVN values at zero-time and during cold storage at 4°C for 3 weeks of different types of sauce

Type of sauce	TBA mg malonaldehyde/Kg sauce				TVN mg N/100 g sauce			
	Zero -time	1wk	2wk	3wk	Zero-time	1wk	2wk	3wk
Chicken-sausage	0.267	0.290	0.305	0.318	15.4	5.8	5.5	5.3
Beef-sausage	0.228	0.242	0.259	0.270	13.6	5.3	5.4	5.1
Pastrami	0.061	0.086	0.097	0.103	5.6	4.2	5.7	6.8

In addition, TVN for chicken and beef salsa products decreased through the storage period. This was due to the large growth of lactic acid bacteria which produced organic acids. The latter reacted with the basic nitrogenous compounds (resulted from the microbial proteolysis) which lead to decreasing the TVN values. Concerning pastrami sauce, TVN was increased after cold storage due to the low growth of lactic acid bacteria which resulted in increasing TPC. Again, the latter caused some nitrogen compound breakdown which resulted in increasing TVN values (Peckham and Freeland-Graves, 1979).

The pH values of the beef-sausage sauce demonstrated the lowest number after 3 weeks of cold storage, (followed by chicken–sausage sauce) and then pastrami sauce to be 4.4, 4.5 and 5.6, respectively (Table, 6).

Table (6): pH values of the different types of sauce at zero-time and during cold storage at 4°C.

Type of sauce	pH value			
	Zero-time	1wk	2wk	3wk
Chicken-sausage	5.1	5.0	4.9	4.5
Beef-sausage	5.1	5.0	4.7	4.4
Pastrami	5.1	5.0	5.2	5.6

This was due to the high growth of LAB which reached 3.8×10^6 CFU/g after 3 weeks of cold storage for beef-sausage sauce (Table, 7). Concerning the chicken-sausage sauce, the LAB count was 3.5×10^4 CFU/g after 3 weeks of cold storage. Although it decreased than the count at zero time; however, it was still large enough to cause the decrease in pH. It is well known that LAB produce organic acids which lead to a reduction in the pH value (Emswiler *et al.*, 1979). However, as expected, the natural flora present in these two types of sauce hydrolysed some protein compounds and produced small amounts of basic nitrogenous compounds. As mentioned before, the latter resulted in the increase of pH values. So, the end result of the natural flora and LAB growth, was the reduction in pH values to reach 4.5 and 4.4 after 3 weeks of cold storage of chicken- and beef-sauce, respectively.

Concerning pastrami sauce, it reached a pH value of 5.6 after three weeks of cold storage (Table, 6) This could be due to low growth of LAB which was in the range of $8.5 - 9.2 \times 10$ CFU/g through the 3 weeks of cold storage. This might be due to the use of partially dried pastrami product (in comparison to the chicken and beef-sausage products) as a meat ingredient (Zoba *et al.*, 2001) which leads to low moisture content in the pastrami sauce. In addition, the growth of the natural flora in pastrami sauce during cold storage had led to the production of basic compounds (Table, 7). The latter leads to increasing the pH value. So, the end result was the increase in pH to reach 5.6 after 3 weeks of cold storage.

Additionally, TPC and psychrophilic count were the highest for beef sauce followed by chicken sauce at zero-time and during cold storage, because of their high moisture contents, while pastrami sauce had much lower TPC and psychrophilic count due to its lower moisture content. However, the large proportion of the microbial flora in sauce products proved to be that of LAB which was beneficial to such products. This is because LAB have been shown to inhibit the growth of other spoilage and pathogenic organisms in food products as shrimp (Moon *et al.*, 1982), frankfurters (Nilsen and Zeuthen, 1985; Wang *et al.*, 1986), mechanically deboned poultry meat (Raccach and Baker, 1979) and yoghurt (Minor and Marth, 1970). Hence, the large proportion of LAB contributed to the long shelf-lives of the beef- and chicken sauces. Although, LAB count was low in the

Table (7) : Total plate count (TPC), psychrophiles and lactic acid bacteria at zero-time and during cold storage for different types of sauce.

Sauce products	Total Plate Count *				Psychrophiles *				Lactic acid bacteria * (LAB)			
	4°C				4°C				4°C			
	Zero-time	1wk	2wk	3wk	Zero-time	1wk	2wk	3wk	Zero-time	1wk	2wk	3wk
Chicken-sausage	2.0×10^5	1.0×10^4	1.0×10^5	5.0×10^5	5.6×10^3	1.2×10^3	8.5×10^4	1.0×10^5	1.0×10^6	1.5×10^6	6.1×10^4	3.5×10^4
Beef-sausage	5.0×10^5	2.0×10^5	6.0×10^5	9.0×10^5	3.0×10^5	1.0×10^5	8.0×10^4	1.5×10^5	2.5×10^6	4.0×10^6	3.9×10^6	3.8×10^6
Pastrami	1.5×10^3	1.0×10^3	6.0×10^3	9.0×10^3	9.2×10^2	8.5×10^2	2.5×10^3	3.5×10^3	8.5×10	9.5×10	9.3×10	9.2×10

* The microbial count was determined as CFU/g.

pastrami sauce, it's low moisture content however, contributed to it's long shelf-life. In addition to microbial inhibitors, mentioned above, the two sausages and pastrami sauces contained salt, sodium nitrite, garlic and spices (Abd El-Aziz, 1990; Wahdan, 1996 and Sharaf, 2002). Furthermore, the sauce mixture contained potassium sorbate. All these components contributed to the long shelf-lives of the sauce products (Laleye *et al.*, 1984; Abd El-Aziz, 1990; Wahdan, 1996; Holley and Mckeller, 1997 and Sharaf, 2002).

Table (8) presents the organoleptic evaluation of the three sauce products after 3 weeks of cold storage. No significant differences at 5% probability were found among the sauce products. So, it is clear that the three types of sauce were evaluated favorably from the view-point of the eating qualities. Finally, it could be concluded that the three sauce products possessed good shelf-lives for three weeks of cold storage.

Table (8): Sensory evaluation (average score) of newly formulated three types of sauce after 3 weeks of cold storage (4°C).

Type of sauce	Color	Aroma	Taste	Texture
Chicken sausage	7.25	7.13	6.85	7.15
Beef sausage	6.80	6.90	7.45	7.10
Pastrami	6.85	6.80	7.20	7.00
L.S.D *	None	None	None	None
S.D. **	18.167	18.479	17.372	13.834

L.S.D. = Least significant differences at 5% probability
S.D. = Standard deviation

This along with the fact that they all were highly evaluated organoleptically; the three suggested sauce formula could be recommended for commercial production.

4. REFERENCES

Abd El-Aziz H.A. (1990). Comparison of Rabbit, Beef and Buffalo Meats for Functional Properties & Sausage Processing. M.Sc. Thesis, Faculty of Agric., Cairo Univ..

Alken A.; Casey, J.C.; Penny, I.F. and Voyle, C.A. (1962). Effect of drying temperature in the accelerated freeze-drying of pork. J. Sci. Food Agric. 13 : 439.

A.O.A.C (1995). Official Methods of Analysis. Association of Official Analytical Chemists. Arlington, Virginia 22202, U.S.A..

Arnolt D.R., Deutschacver C.L and Bullock D.H. (1974). Microbiological evaluation of yoghurt processed commercially in Ontario. J. Milk Food Technol., 37 : 11.

Defreitas, Z. and Molins, R.A. (1988). Development of Meat Snack Dips: Chemical, physical, microbiological and Sensory characteristics. J. Food Sci., 53 (6) : 1645-1649.

Desrosier, N.W. (1984). Elements of Food Technology. AVI Publishing Company Inc., Westport, Connecticut, U.S.A.

Dotson R.S., Hilmer A.F. and Covaletto C.G. (1977). Indirect methods as criteria of spoilage in tofu (protein curd). J. Food Sci., 42 : 273.

Emswiler B.S., Pierson C.J., Kotula, A.W. and Cross H.R. (1979). Microbiological evaluation of precooked beef patties containing soy proteins. J. Food Sci., 44 : 154.

Goel M.C., Kulshrestha D.C. and Marth E.H. (1971). Fate of coliforms in yoghurt, buttermilk sour cream and cottage cheese during refrigerated storage. J. Milk Food Technol, 34 : 54.

Harold J.B. (1967). Microbial Applications. Wm.C. Brown Company Publishers.

Harrison M.A., Draughon F.A. and Melton C.C. (1983). Inhibition of spoilage bacteria by acidification of soy extended ground beef. J. Food Sci., 48 : 825.

Holley R.A. and McKellar R.C. (1997). Influence of unsliced delicatessen meat freshness upon bacterial growth in subsequently prepared vacuum packed slices. International J. of Food Microbiol., 20 (2/3) : 297-309.

Laleye L.C., Lee B.H., Simard R.E., Camichael L. and Holley R.A. (1984). Shelf-life of vacuum or nitrogen-packed pastrami : Effects of package atmospheres : Temperature and duration of storage on microflora changes. J. Food Sci., 49 (3) : 827-831.

Leveille G.A. (1988). Current attitude and behavior trends regarding consumption of grains. Food Technol. 42 (1) : 110.

Liewen M.B. and Marth E.H. (1985). Growth and inhibition of microorganisms in presence of sorbic acid : A review. J. Food Prot., 48 : 364.

Lunck, E. (1980). "Antimicrobial Food Additives. Characteristics Uses-Effects". Springer Vering, Berlin.

Minor T.E. and Marth E.H. (1970). Growth of *Staphylococcus aureus* in acidified pasteurized milk. J. Milk Food Technol., 33 : 516.

Moon N.J., Beuchat L.R., Kinkaid D.T. and Hays E.R. (1982). Evaluation of lactic acid bacteria for extending the shelf-life of shrimp. J. Food Sci., 47 : 897.

Nilsen H.J.S. and Zeuthen P. (1985). Influence of lactic acid bacteria and the overall flora on development of pathogenic bacteria in vacuum-packaged cooked emulsion-style sausage. J. Food Prot., 48, 28.

Osheba A.S. (2003). Studies on the preparation and evaluation of some healthy foods.Ph.D.Thesis, Fac. of Agric., Menufiya Univ.

Pearson D. (1970). The Chemical Analysis of Food. National College of Food Tech., Univ. of Reading, Weybridge, Surry J. and Curchill.

Peckham G.G. and Freeland-Graves J.H. (1979). Foundations of Food Preparation. Macmillan Publishing Co., Inc., New York-Collier Macmillan Publishers, London.

Raccach M. and Baker R.C. (1979). The effect of lactic acid bacteria on some properties of mechanically deboned poultry meat. Poultry Sci., 35 : 787.

Rehberger T.G., Wilson L.A. and Glatx B.A. (1984). Quality of commercial tofu. J. Food Prot., 47 : 177.

Sharaf S.M. (2002). Technological Studies on Some Poultry Wastes and By-Products for Dietary Uses. Ph.D Thesis, Fac. of Agric., Cairo Univ..

Snedecor G.W. and Cochran W.G. (1980). "Statistical Methods". 7th Ed, Iowa State Univ. Press., Ames., Iowa, U.S.A..

Speck M.L. (1976). Compendium of Methods for The Microbiological Examination of Foods. American Public Health Association, 1015 Eighteenth Street N.W., Washington DC 20036, U.S.A.

Steinberg A. (1983). Yoghurt : The perfect base; how to create tantalizing dips. Dairy Res., 84 (4) : 117.

Wahdan A.N. (1996). Some studies on the processing of Marine Turtle Meat. Ph.D. Thesis, Faculty of Agric., Al-Azhar Univ..

Wang S.Y., Dockerty T.R., Ledford R.A. and Stouffer J.R. (1986). Shelf-life extension of vacuum packaged frankfurters made from beef inoculated with *Streptococcus lactis*. J. Food Prot., 49 : 130.

Watts B.M., Yamaki G.L., Jeffrey L.E. and Elias L.G. (1989). Basic Sensory Methods for Food Evaluation. 1st Ed., The International Development Research Center Pub., Ottawa, Canada.

Winton A.L. and Winton R.B. (1958). Okoloff Magnesium Oxide Distillation Volumetric Method. The Analysis of Food. John Willey and Hull, New York, London.

Zoba M.A., El-Seesy T.A. and Ibrahim K.E. (2001). Physical, Chemical and Microbiological Studies on the Sausage Processed with Pastrami Coating Mixture. J. Home Economics- Menufiya Univ., 11 (1) : 45.

تحضير وتقييم أنواع مختلفة من الصلصة المدعمة ببعض منتجات اللحوم المصنعة

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ملخص

تم إنتاج ثلاث أنواع من الصلصة يحتوي كل منها علي ٤٠% من أحد منتجات اللحوم (سجق دجاج ، سجق لحم أو بسطرمة) علاوة علي لبن رائب ، زبادي ، توفو ، سوربات بوتاسيوم وكاراجينان. و تم إعداد هذه المنتجات من الصلصة ليتم تناولها مع شرائح البطاطس المقلية حتي تصبح وجبة متكاملة.

وجد أن صلصة اللحم كانت تحتوي علي أعلي نسبة من الرطوبة والدهن بينما صلصة البسطرمة كانت تحتوي علي أعلي نسبة من البروتين. وبعد ٣ أسابيع من التخزين البارد (٤°م) فإن أعلي معدل نمو لبكتيريا حمض اللاكتيك وايضاً أقل قيمة للـ pH (٤.٤) كانت لصلصة اللحم. بينما كان أقل معدل نمو لبكتيريا حمض اللكتيك وأعلي قيمة للـ pH (٥,٦) كانت لصلصة البسطرمة.

أمكن حفظ الثلاثة أنواع من منتجات الصلصة لمدة ٣ اسابيع في المبرد علي ٤°م. وكانت قيم حمض الثيوباربيتيوريك الدالة علي أكسدة الدهون والنيتروجين الكلي المتطاير والعد الكلي للبكتيريا في الحدود المسموح بها. ولم تلاحظ فروق معنويةعند التقييم الحسي للمنتجات الثلاثة من الصلصة. يمكن ذلك إنتاج هذه الأنواع من الصلصة علي مستوي تجاري.

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