

THE TRADITIONAL ALEXANDRIA SEMIDRY SAUSAGE 1- QUALITY ATTRIBUTES OF MARKET PRODUCT

T. NOUMAN*, A. DARWISH*, ZINAB NIAZI** and HODA AIEDIA**

* Dept. of Food Hygiene, Fac.Vet. Med. Cairo Univ.

**Dept. of Food Hygiene, Animal Health Research Inst, Giza.

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SUMMARY

The examined market traditional Alex. semidry sausage revealed that; the accepted product appearance is the marble cure. Deviations were, over cure, fading, browning, foreign colours, mouldy, slimy and greening of the core. The normal flavour reported is the fleshy cure one. But rancid, putrid and sour flavour were reported as deviations.

The main technical defect reported was the fat smearing, which is a mincing error. The ripening/ drying defects reported were softening, collapsing, case hardening and joint sours beside irregular curing.

The tests applied for freshness attributes evaluation revealed that a pH value lower than 4.8 is indicative of undesirable sourness. The malonaldehyde content/gm of extracted fat is a reliable test for fat oxidation evaluation in the product,

and a value higher than 40ug/gm fat is to be considered border-line.

The chemical analysis of the product revealed a reasonable fat and moisture content, but unnecessary high carbohydrate on the expense of the protein.

The microbiological analysis of the market samples revealed an average count of 1.1×10^7 , 1.5×10^3 , 3.7×10^3 , 1.8×10^3 and 1.2×10^2 for the total aerobic, anaerobic, Staph.aureus, enterobacteriaceae, mould & yeast counts respectively. Salmonellae failed detection while E.P *E.coli*. could be isolated from 7 samples.

The deviation from the accepted organoleptic attribute had been discussed. The impact of oxidized fat, overdosing of nitrite as well as the pathogenic *E. coli* to man health had been highlighted.

INTRODUCTION

The Alex. sausage is a semidry naturally fermented air dried beef product, natural beef rounds are the traditional used. The product is usually presented in a double or triple chains of fingers or in a ringform. Sometimes being smoked but not cooked. Most of the market presentation is done hanged at room temperature. The product is long known in Cairo, Alexandria and Port-Said. Its production was initiated by some Egyptian citizens of Armenian origin (over 100 years ago), and still some members of these families beside other Egyptians do the job.

Nouman (1997) described the processing operation as follows; fresh frozen beef i.e. not long stored with about 20% fat, or lean beef and fresh beef fat are better used. Meat and fat are minced frozen at 4mm. The mincing set used must be enough sharp to avoid squeezing. In a baddle blender; meat is placed, a portion of a previous meat mix is sometimes added; then the curing salts including; common salt, nitrite, ascorbic and sugars but no phosphates, no water were added. The mix is then blended for few minutes, spices are then added, blended again but not to develop binding. Some processors fill the mass in a curing vats overnight in a cold chamber then being filled next morning. Ripening is made by keeping the the stuffed product over night inside the plant then left to dry under a shade in the open. During the ripening/ drying time a gradual

pH reduction as well as gradual loss of moisture from the sausage occur. Within a couple of days complete ripening develop which is noted by firmness of the product as well as the characteristic cure colour and aroma of the product. The sausage is then dispatched. Beside the firm texture and the specific cure colour and aroma of the product, the cut surface of the sausage characterised by the marble fat particles distribution over the cured lean is background. It is important to report that; most of basterma producers, do produce that Alex. sausage as a side product, to make use of the trimmings coming out of the basterma meat preparation. Another observation to be reported is that; because the market competition now - a - day is running pricewise, many producers incorporate none-meat extenders with colourants to reduce the final cost and hence the original product attributes are nearly lost.

The dry and semidry sausages are studied intensively by many investigators among of them (Niven et al, 1949 & 1959; Youssef et al, 1966; Takacs & Simonfly; 1970; Awad & Youssef; 1973; Stolic, 1975; Tatini et al. 1976; Rust, 1977; USDA, 1977; Terrel et al, 1978; Schneider, 1980 and Ingolf & Skjelkvale, 1982). But this very traditional product escaped the interest of our local inestigators. Therefore this work had been planned to study the quality attributes of the market product as regard the organoleptic, freshness parameters, naturitional contribution as well as the microbiological state. The accepted attributes,

deviations and errors shall be determined and defined. The possible solution for deviations and errors are to be dealt with in a separate work.

MATERIALS AND METHODS

The producers of the traditional Alexandria semidry sausage were first determined, their production sites were visited, evaluated visually then being sorted according to the hygiene condition, production practice, machinery up dating and availability or not of any quality certifications and any quality assurance system into grades. In fact none of the visited sites could be sorted as grade I but only grade II and III were report. The product of five plants of each of grade II and III factories were looked for in the market and sampled. Twenty samples for each factory grade (total 40 samples) were taken from the market, transferred to the lab. For further investigation.

A- The organoleptic attributes:

The parameters looked for in this survey included the determination and definition of the accepted and deviated appearance and flavour of the product, beside the determination of the accepted technical parameters and the reporting of the possible errors. The applied landmarks in this investigation are collected from (Price & Schweigert, 1971; Bacus 1984; Pearson & Tauber, 1984; Koch, 1986 and Varnam & Sutberland 1995).

B- Freshness attributes:

Include pH value of the product (ISO, 1974), and for the extracted fat the acid value (Kates, 1972; Pikul et al., 1983 and Metcalf, 1979), peroxide number (A.O.A.C., 1990), Thiobarbituric acid reactive substances (TBA). Malonaldehyde content/gm. fat according to (Tarladgis *et al.* 1960; Pikul et al., 1983 & 1989, Sinnhuber & Yu, 1985 and Yu et al., 1986). Also the total volatile base nitrogen (TVBN) according to (FAO, 1980) was determined.

C- Nutritional attributes:

Include the determination of; moisture content (ISO 1973a), total, protein (AOAC 1990), fat content (ISO 1973b), total carbohydrate (Dubois et al., 1956), sodium chloride (AOAC 1990), ash content (ISO 1978) and nitrite (ISO 1975a).

D- Microbiological attributes:

The following microbial counts are determined; total aerobic (ISO, 1976), total thermophilic (Harrigan & Mc Cane 1976; and Collins & Lyne, 1984), anaerobes (Brewer & Allgeier, 1966), *Staphylococcus aureus* (FAO, 1992) and total yeast and mould count (Balley & Scott, 1974). Beside; a test for salmonellae (ISO, 1975) and Harvey & Prico 1981) and for enteropathogenic *E.coli* (ICMSF, 1978).

RESULTS AND DISCUSSION

Table 1 revealed that 55% of the market product possessed the accepted marble cure appearance. Deviations in appearance as reported include; over

cure, fading, browning, greening, none-meat colour (foreign colour), mouldy, slimy and green core. It had been observed that out of 22 samples reported as normal marble cure from the outside inspection, 7 of them contained colourants when the contents were examined. Moreover, more than one appearance deviation was reported for the same sample in some of them. The over cure deviation which is a reflection of nitrite overdosing was more frequent in samples produced by producers graded as III, than those from grade II producers.

The accepted cure flavour was reported for 57.5% of the examined samples. Deviations reported were rancid, putrid and sour. The rancid and putrid flavours noted were a reflection of the use of too old raw meat (Bacus, 1984) and in this specific product the use of the basterma trimmings as had been observed magnify the problem (bad hygiene in collection and trimming). The sour flavour reported could be attributed to over fermentation; high moisture content, carbohydrate and the high microbial load in the samples noted as soure are collaborating factors (Fraizer & Westhoff, 1978).

The technical landmarks looked for included; the condition of fat comminution, vice; correct or smeared. The outside condition of the casing vice; regular dry, soft,, collapsed, hard and the presence of joint sour at the sausage finger extremities. Beside the homogeneity of the curing of the sausage contents. The common fault reported was the fat smearing in 40% of the sam-

ples. Such defect is commonly reported for factories using none branded or primitive mincers. Also the use of unsharpened mincing set results in meat squeezing and fat smearing during comminution. Such a faulty practice results in the afore mentioned sausage error (W.E.P., 1985). The reported fermentation and drying errors i.e. soft sausage, collapsed casing, case hardening and joint sour, are basically due to the lack of controls during the ripening, fermentation and drying operation. Temperature, air velocity and RH are the parameters controlling the previously mentioned operation (Bacus, 1984). The joint sour defect is due to the permanent, continuous contact between the extremities of the adjacent sausage fingers without enough space for aeration (Frazier & Westhoff, 1978). The irregular curing of contents of a sausage finger could be the function of oxidized fat in the raw beef, the beef contain much collagen and/ or incorporation of much none meat extenders in the formula (W.E.P., 1985; Angelo & Bailly, 1987 and Monahan et al., 1992).

Table 2 illustrated the freshness criteria including the pH value, peroxide number and TBA value for fat in addition to the TVBN value for protein. The reported pH values seems normal for the semidry sausage except for some samples which had a pH value of 5.7 and others with 4.2 and these as revealed from the detailed results were noted as putrid or sour (Terrel et al. 1978). The detailed results also revealed that rancid samples always had an acid value higher than 3 and a peroxide number higher than 20, with an MD value

higher than 40 ug/gm extracted fat. It is important to report that the present product being naturally fermented i.e. not selective (hetero fermentation), it happened through the growth of some microorganisms capable of fat degradation either hydrolysis and or oxidation via oxidases which enhance malonaldehyde (Lechowich, 1978).

Table 3 revealed that the average moisture content was 46.5%, ranged from 41.4 to 52.1%. Such moisture range together with the pH reported for the examined samples prove that the Alex. sausage would be considered within the semidry group (Bacus, 1984). From the frequency distribution (table 4), it is evident that only 7.5% of the samples had moisture content higher than 50%. It is also evident that grade II producers are more skillful in drying the sausage than those of grade III. The protein content ranged between 12.8 to 20.4% with an average of 16.1%. Despite the moisture content may seem acceptable, yet the moisture: protein ratio was higher 2.8 in 52.5% of the examined samples.

Such a value higher than 2.8 is not accepted for the semidry sausage (A.M.I. 1982). An explanation for that wide MPR, is the high carbohydrates incorporated in the product, which ranged between 9.2-15.8% with a mean of 12.4%. Such values are not accepted for the semidry product (Pearson & Tauber, 1984). On the other hand, the fat content of all the ex-

amined samples were in the range of semidry sausage (Bacus, 1984), and so is the sodium chloride content (Terrell et al., 1978). The relative high ash content (2.8 to 5.8%) with a mean of 4.6% is an indication for the incorporation of much nonmeat extenders in the product (Smith, 1991). The nitrite residue estimation ranged between 70 p.p.m to 180 p.p.m with a mean of 131.6 p.p.m. Such values are alarming.

Table 5, indicated the microbiological attributes of the market product. The aerobic count values could be considered in the high margin common to the semidry sausage (Bacus, 1984). While the counts for *Staphylococcus* and anaerobes are relatively high (Deibel et al. 1961; Acton & Dick, 1976 and Farber et al, 1988).

Seven samples out of 40 contained *E.P.E. coli*, the isolates were; O₁₂₇:H₇ and O₁₁₉:K₆₉(B₁₄). The first serotype is common with haemorrhagic colitis in man (Riley et al, 1983; Doyle & Schoeni, 1984 and Mac. Donald 1985).

The risk of oxidized fat intake to man had been discussed by Pearson and Dutson (1990) and they declared that fat oxidation products are chronic toxicants in man and contribute to the aging process, cancer and cardiovascular disease. In the experimental animals they reported a variety of disorders including hepatic dysfunction and aortic lesions. Hence the low rancid flavour of oxidized fat is to be alarming to the consumer to reject the food to protect and to be

Table (1): Organoleptic Attributes Of Market Traditional Alexandria Semidry Sausage

Factory grade	Appearance									Flavor			Technical Properties									
	Normal marble cure	Over cure	Fading	Discoloured					Normal Fleshy cure flavor	Deviations			Fat		Casing				Curing			
				Browning	Greening	Foreign colour	Moldy	Slimy		Green core	Rancid	Putrid	Sour	Correct	Comminuted	Smearing	Greasing	Regular dry	Soft	Collapsing	Casing Hardening	Joint sours
II	13	5	4	6	3	14	6	3	4	13	6	3	1	14	6	13	4	2	4	7	12	8
III	9	8	3	6	6	15	6	4	4	10	9	3	2	10	10	9	6	4	6	8	11	9
Total	22	13	7	12	9	29	12	7	8	23	15	6	3	24	16	22	10	6	10	15	23	17
%	55	32.5	17.5	30	22.5	72.5	30	17.5	20	57.5	37.5	15	7.5	60	40	55	25	15	25	37.5	57.5	42.5

Table (2): Freshness Attributes Of Market Traditional Alexandria Semidry Sausage

Factory grade	PH value		Fat oxidation criteria					TVBN
	Outer	Core	Acid Value	Peroxide number	Malonaldehyde concentration			
					Fat %	Ug MD/gm	TBA Value	
II	5.4	4.9	2.58	18.3	19.9	38.8	0.76	17.8
III	5.2	4.8	2.9	20.0	20.1	43.0	0.86	18.8
Total mean	5.3	4.8	2.7	19.1	20.0	40.9	0.81	18.3
Maximum	5.7	5.6	3.6	26.0	24.3	65.0	1.15	28.0
Minimum	5.0	4.2	1.6	11.0	15.1	23.0	0.54	8.0

Table (3): Nutritional Contribution Of Market Traditional Alexandria Semidry Sausage

Factory grade	Moisture	Protein	Fat	Carbohydrate	Na Cl	Ash	Moisture Protein	Nitrite (p.p.m)
II	45.5	17.5	19.9	12.4	2.8	4.5	2.5	128.5
III	47.6	14.8	20.1	12.4	2.8	4.8	3.2	134.6
Total mean	46.5	16.1	20.0	12.4	2.8	4.6	2.8	131.6
Maximum	52.1	20.4	24.3	15.8	3.8	5.8	3.9	180.0
Minimum	41.4	12.8	15.1	9.2	2.0	2.8	2.0	70.00

Table (4): Frequency Distribution Of Examined Samples According to their Nutritional Contribution

Moisture		Protein		Fat		Carbohydrate		Sodium Chloride		M/P ratio	
Interval	%	Interval	%	Interval	%	Interval	%	Interval	%	Interval	%
35-40	12.5	12.8 -14	12.5	13 - 16	5	8 -10	10	2.0 -2.4	35	<2.3 -2.3	10
-45	22.5	-16	35	-19	27.5	-12	30	-2.8	12.5	-2.8	37.5
-50	57.5	-18	37.5	-22	45	-14	40	-3.2	20	-3.3	37.5
-55	7.5	-20	15	-25	22.5	-16	20	-3.9	32.5	-3.8	15

Table (5): Microbiological Attributes Of Market Traditional Alexandria Semidry Sausage

Factory grade	Microbial counts / gm						Test for	
	Total Aerobic count	Anaerobic	Staph.aureus	Enterobact eriaceae	Mold	Yeast	Salmon ellae	E.P.E.C.
II	8.8×10^6	1.1×10^3	1.8×10^2	1.9×10^3	9.3×10^2	3.6×10^2	0	3
III	1.5×10^7	1.9×10^3	5.7×10^2	4.5×10^3	2.8×10^3	2.1×10^3	0	4
Total mean	1.1×10^7	1.5×10^3	3.7×10^2	3.2×10^3	1.8×10^2	1.2×10^3		
Maximum	9×10^7	9×10^3	2×10^3	2×10^4	9×10^3	8×10^3		
Minimum	2×10^3	$< 10^2$	$< 10^2$	$< 10^2$	$< 10^2$	$< 10^2$		

E.P.E.C. Enteropathogenic *Echerichia coli*

protected from the health hazards connected to lipid oxidation products.

The reported high nitrite content in the product is very alarming, since the product is stored raw and subject to frying at a kitchen level, this beside the availability of unstruated fat or oil develop pseudonitrosites during frying (Hotchkiss et al., 1986). This and the available nitrosamines are no doubt a cancer inducing

agents (Ender et al, 1967)

Not only the intentional nitrite overdosing and the risky fat oxidation product may harm the consumer health but also the over all microbiological quality of the product is pessimistic. Particularly the high load of anaerobic bacteria, staphylococci and the isolated and identified *E.P.E.coli*.

REFERENCES

- Acton, C.T. and Dick, L.R. (1976): Composition of some commercial dry sausages. *J. Food Sci.*, 41
- A.M.I. (1982): Good Manufacturing Practice, Fermented dry and semi-dry sausage. Am. Meat Inst., Washington, DC,
- Angelo, A.J. and Bailey, M.E. (1987): Warmed over flavour of meat. Academic Press, Orlando, FL, USA.
- A.O.A.C. (1990): Association of official analytic chemists. Official methods of analysis, 15th Edition.
- Awad, A.H. and Youssef, M.K.E. (1973): Der Einfluss Ingeres Kuhlagerung (+4°C) und auf die koli Gruppe in daurwurstem und in pasterma. *Schlacht und Viehof - Zeitung* 3-85
- Bacus, J. (1984): Utilization of Microorganisms in meat processing. John-Wiley and sons, Inc., New York.
- Balley, W.R. and Scott, E.G. (1974): Diagnostic Microbiology, identification of pathogenic microorganisms. 4th Ed., the C.V., Mosby Co., Saint Louis.
- Brewer, J.H. and Allgeier, D.L. (1966): Self contained carbon dioxide hydrogen anaerobic system. *Appl. Microbiol.*, 41:895.
- Collins, C.H. and Lyne, P.H. (1984): Microbiological Methods. 5th Ed., Butter and Tanner Ltd., London, Boston.
- Deibel, R.H.; Niven, C.F. and Wilson, D.D. (1961): Microbiology of meat curing. III-Some microbiological and related technological aspects in the manufacture of fermented sausage. *App. Microbiol.*, 9:156.
- Doyle, M.P. and Schoeni, J.L. (1984): Survival and growth characteristics of *Escherichia coli* associated with hemorrhagic colitis. *Appl. Environ. Microbiol.*, 48:855.
- Dubois, M.; Gilles, K.A.; Hamilton, J.K.; Robert, P.A. and Smith, F. (1956): Colorimetric method for determination of sugars and related substances. *Anal. Chem.*, 28 (3):350.
- Ender, F., Harve, G.N., Madsen, R., Cech, L. and Helgebostad, A. (1967): Studies on conditions under which N-nitrosodimethylamine is formed in herring meal produced from nitrite-preserved herring, *Z. Tierphysiol. Tierernahr. Futtermittelkd.* 22, 181.
- F.A.O. (1980): Food and Agriculture Organization of United Nation. Manual of food quality control, United Nation, Rome.
- F.A.O. (1992): Food and Agriculture Organization of United Nation. Manual of food quality control. I-Microbiological analysis. *Staphylococcus counts*, P.131.
- Farber, J.M.; Malcolm, S.A.; Weiss, K.F. and Johnston, M.A. (1988): Microbiological quality of fresh and frozen breakfast-type sausage sold in Canada. *J. Food Protection*, 51; 397.
- Frazier, W.C. and Westhoff, D.C. (1978): Food Microbiology 3rd Ed., Tata McGraw-Hill Publishing Co., Ltd.
- Harrigan, W.F. and McCance, M.E. (1976): Laboratory methods in food and dairy microbiology Academic press, Inc., London, Ltd.
- Harvey, R.W. and Prico, T.H. (1981): Comparison of selenite F, Muller kauffmann tetrahydroionate and rappaport medium for salmonella isolation from chicken giblets and after pre-enrichment in buffered peptone water. *J. Hyg. Camb.*, 87:219.
- Hotchkiss, J.H., Vecchio, A.J. and Ross, H.D. (1986): N-nitrosamine formation in fried-out bacon fat: Evidence for nitrosation by lipid bound nitrite. *J. Agric. Food Chem.*, 23,5

- ICMSF (1978): International Committee on Microbiological Specifications for foods 2nd Ed., Univ. of Toronto press, Toronto, Buffalo and London.
- Ingolf, F.N. and Skjelkvale (1982): Effect of natural species and oleoresins on *Lactobacillus plantarum* in fermentation of dry sausage. *J. Food. Sci.*, 47: 1618.
- ISO (1973)a: International Standard Organization 1443-1973. Meat and Meat products: Determination of Moisture content.
- ISO (1973)b: International Standard Organization 1442-1973. Recommended Methods: Determination of total fat content of Meat and Meat products.
- ISO (1974): International Standard Organization 2917-1974. Meat and Meat products: Measurement of pH (Reference method).
- ISO (1975)a: International standard Organization 3565-1975. Determination of Nitrite content. (Reference method).
- ISO (1975)b: International standard Organization 2913-1975. Meat and Meat products: Detection of salmonella (Reference method).
- ISO (1976): International standard Organization 2293-1976. Meat and Meat products: Aerobic count at 30°C (Reference method).
- ISO (1978): International standard Organization 936-1978. Meat and Meat products: Determination of Ash (Reference method).
- Kates, M. (1972): In *Laboratory Techniques in Biochemistry and Molecular Biology Work*, T.S & Work, E. Eds.; North-Holland publishing Amsterdam, 192; 347.
- Koch, H. (1974); *Die Fabrikation Feiner Fleisch-und Wurst Waren*. Deutscher Fachverlag.
- Lechowich, R.V. (1978): In *the Science of Meat and Meat products*. Edited by : J.F. Price and B.S. Schweigert, P.262, Food and Nutrition Press, Westport, Conn.
- MacDonald, K. (1985): Outbreak of *Escherichia coli* O157:H7 diarrheal illness in a nursing home, Nebraska. *Abst. Food Research Institute Ann. Spring Mtg.*, Madison, WI.
- Metcalf, L.D. (1979): Traditional analytical chemistry of fatty acids and their derivatives. *J. Am. Oil chemists Soc.*, 56: 786A.
- Monahan, F.J.H.; Brooren, A.M.; Miller, E.R Buckley, D.J.; Morrissey, P.A. and Gommaa, E.A. (1992): Influence of dietary treatment on lipid and cholesterol oxidation in pork. *J. Agric. Food. Chem.*, 40: 1310.
- Niven, C.F.Jr; Castellani, A.C., and Wilson, G.D. (1949): A study of the lactic acid bacteria that cause surface discoloration of sausage. *J. Bacteriol.*, 58:633.
- Niven, C.F.Jr.; Deibel, R.H. and Wilson, G.D. (1959): Production of fermented sausage. U.S. patent, 2,906,661.
- Nouman, T. (1997): *The further processing of Beef in Notes on Meat. Technology and Preservation*, Cairo Univ. Fac. Vet. Med. Press.
- Pearson, A.M. and Tauber, F.W. (1984): *Processed Meats*. 2nd Ed. AVI Publishing Company, Inc.
- Pearson, M.A. and Dutson, R.T. (1990): *Meat and Health*. Elsevier. Appl. Sci. U.K.
- Pikul, J. Leszczynski, D.E. and Kummerow, F. (1983): Elimination of samples autooxidation by butylated hydroxytoluene additions before thiobarbituric acid assay for malonaldehyde in fat from chicken meat. *J. Agric. Food Chem.*, 31:1338.
- Pikul, J.; Leszczynski, D.E. and Kummerow, F. (1989): Evaluation of three modified TBA methods for measuring lipid oxidation in chicken meat. *J. Agric. Food Chem.*, 37; 1309.

- Price, J.F. and Schweigert, B.C. (1971): *The Science of Meat Products* 2nd Ed., W.H. Freeman & Co., Sain Francisco.
- Rilley, L.W.; Remis, R.S.; Helgerson, S.D.; McGee, H.B.; Wells, J.G.; Davis, B.R.; Herbert, R.J.; Olcott, E.S.; Johnson, L.M.; Har-grett, N.T.; Blake, P.A. AND Cohen, M.L. (1983): Hemorrhagic colitis associated with a rare Escherichjai coli serotype *New Engl. J. Med.*, 308: 681.
- Rust, R.E. (1977): *Sausage and Processed meat manufacturing*. American Meat Insitute, Chicago, Illions P.24
- Schneider, H. (1980): Dry and semi-dry sausage technology primer. *Meat Industry*, Oct., P.62
- Sinnhuber, R.O. and Yu, T.C. (1958): Characterization of the red pigment formed in the 2-thiobarituric acid terminator of oxidative rancidity. *Food. Res.*, 23:626.
- Smith, J. (1991): *Food Additive Users. Hand Book*, Published in the USA by AVI.
- Stolic, D.D. (1975): Qualitative relationship between micrococci and Lactobacilli during ripening of fermented sausage and factors influencing ths relationship. *Acta Vct. Beograd.*, 25:91.
- Takacs, J. and Simonfly, Z. (1970): Das Salmonellenproblem bei-Daucrwursten. *Flwischwirtschaft* 50; 1200.
- Tarladgis, B.G.; Watts, B.M.; Younathan, and Dugan, L.R. (1960): A distillation method for the quantitative determination of malonaldehyde in rancid foods *J.Am. Oil Chem. soc.*, 37:44.
- Tatini, S.R.; Lee, R.Y.; McCALL, W.A. and Hill, (1976): Growth of *Staphylococcus aureus* and production of enterotoxins in pepperoni. *J.Food Sci.*, 41:223.
- Terrell, R.N.; Smith, G.C. and Carpenter, Z.L. (1978): *Practrical manufacturing technology for dry and semi-dry sausage*. In proc. 20th Ann. Meat Sci. Inst. Athens, Ga.
- United States Department of Agriculture (USDA) (1977): *The staphylococcal enterotoxin problem in fermented sausage Task Force Report*, F.S.Q.S., Washington, DC.
- Varnam, A.H. and Suterland, P.S. (1995): *Meat and Meat products. Technology, Chemistry and Microbiology*. Chapman & Hall press Co.
- W.E.P. (1985): *The word empolyments programme. Technology Series, Memorandum No.10*, Geneva.
- Youssef, M.K. Habib, A.A. and Awad, H.A. (1966): *Studies on locally manufactured dry sausage and basterma part I Gross chemical compsiton and nutritive value*. Assiut Univ. College of Agric. Dept. of food Tech.
- YU, L.W.; Latriano, L., Duncan, S.; Hartwick, R.A. and Witz, G. (1986): High-performance liquid chromatography analysis of the thiobarbituric acid abducts of malonaldehyde and trans-muconaldehyde. *Anal Biochem.*, 156:326.