Egypt. J. Agric. Res. , 77 (1), 1998.

QUALITY ATTRIBUTES OF SMOKED SAUSAGE MANUF ACTURED FROM COMMON CARP FISH IN RELATION TO DIFFERENT LIQUID SMOKING METHODS AND COOKING

E.A. MOGHAZY, B.M. DARWIESH AND T.A. EL-SEESY

Food Technology Research Institute, Agricultural Research Center. Giza, Egypt.

(Manuscript received 2 July 1997)

Abstract

To overcome the low popularity of common carp fish (*Cyprinus carpio*), mainly the undesirable flavour and the presence of much spines in flesh, processing of smoked comminuted flesh products as the fish sausage seems to be the solution for such a problem. Smoking of carp sausage was carried out by 4 methods which were 1) "T1" spraying or liquid smoke aerosol method, 2) "T2" dipping or soaking for 20 seconds in a 25% liquid smoke solution,3) "T3" direct mix where liquid smoke was directly blended with the sausage ingraedients, and 4 "T4" where spices, salt, starch and fat received separately a repeated spray treatment with liquid smoke before sausage processing. Cooking of sausage was carried out in water at 85oC for 15 minutes. Analysis revealed very slight differences between treatments with respect to the moisture content, provided that sausage of T3 tended to have slightly higher water content regardless of cooking; the latter caused some decrease in the moisture content. Before as well as after cooking, T2 sausages had lower pH value (4.82-4.90) compared to the other treatments; T1, T3, and T4 (5.81-5.99), while the control sample had higher pH value (6.06 - 6.07); cooking increased the pH value except the T2. Phenols followed the same trend of organic acids in tissues (as indicated by the lower pH value); being higher for T2, followed by T1, T4, T3, and control either before or after cooking; the later caused marked loss of phenols with cooking water. Smoking treatments and cooking did not affect the total volatile nitrogen (T.V.N) or thiobarbituric acid (T.B.A) values of the fish sausage. Cooking yield and loss varied within 1% for the different treatments. Water holding capacity (WHC) and plasticity were evidently high for T2, sausage which also had the lowest total bacterial count lipoltic and proteolytic bacteria either before or after cooking, smoking as well as cooking were efficient in reducing the bacterial loads. Best eating qualities as indicated by the panel test were found for T2, which is suggested for commercial production.

INTRODUCTION

The conventional method for production of the typical flavour in smoked products has been performed via exposing the product to smoke generated by the partial combustion of certain hard wood or sawdust, This traditional method have many disadvanlages such as the depositing and penetration of unwanted and undesirable substances (Gorbatova *et al.*, 1971). Therefore, there has been a good deal of activity recently looking towards the prospect of developing proper substitutes. Also, better and more economical procedures and means are needed for producing smoked products with the high smoked flavor quality. Recently, in certain countries the so called smoked concentrates and accordingly liquid smoke became quit popular. Moreover, the liquid smoke preparations, manufactured from wood pyrolsates are claimed to show many advantages over the traditional smoking in a kiln including, elimination of undesirable substances and non-functional materials, controlling of concentration of coloring and flavoring compounds, uniformity of the smoked product, easiness of application which could be applied by several methods, also, reducing the production time, costs and the environmental pollution (Maga, 1988).

The versatility of liquid smoke condensate allows it to be applied by several routes including; the external dip (Sink and Hsul, 1977 and Munker and Meyer, 1994), direct mix where liquid smoke used as an ingredient, aerosol (Wistreich, 1979 and Moghazy, 1994) and via indirect mix where liquid smoke absorbed in carriers such as spices, starch, salt and fat then added to the food product formula (Toth and Pothast, 1984). Gorbatova *et al.*, (1971) reported that the amount of added liquid smoke directly to the sausage formula, as an ingredient may range from 0.2 - 1.0% of the minced meat weight.

Sink and Hsul (1977) and Horner, (1992) found that the method of liquid smoke application affect the amount of moisture, phenol and total volatile nitrogen (T.V.N.) as well as the pH value and the thiobaribturic acid (T.B.A.) values; they added that the liquid smoke as external and direct mix had a strong antioxidant effect. Moreover, the same authors noticed that T.V.N. and pH, both are highly affected by the amount of phenols. Also, Radetic *et al.*, (1982) found that the water holding capacity (W.H.C.) was inversely related to the concentration of phenols in smoked products. Moreover, Hassanin, (1993) reported that a decrease occurred in the T.B.A. values of carp fish sausage after the smoking process, and this was attributed to the antioxidative action of smoke phenols.

From the microbiological aspect, oluski and zinvanovic, (1976) concluded that liquid smoke prepartion, when used at levels up to 2% did not have bactericidal effect, on the other hand, Donnelly *et al.*, (1982) noticed that liquid-smoke solutions had bactericidal action and they supported their results by using pure cultures of some test microorganisms. Munker and Meyer, (1994) proved that liquid smoke as dip was preferred compared to liquid smoke-aerosols in smoking of fish products. The same authors added that liquid smoke treatment appeared to have bactericidal as well as bacteriostatic properties.

It is worth mentioning that carp fish production, although largely practiced in fish cultures, it is not accepted by the Egyptian consumers, neither as a whole or as fish fillets, due to flesh spines (thin intramuscular bones that penetrate the flesh itself), in addition to unpleasant flavour and the rapid development of fat rancidity (Shabaan, 1994), thus, this fish species is facing marketing problems which riauire the applicable solutions. Therefore, common carp fish was chosen to manufacture new products.

The aim of this work is to find an applicable solution for the spines problem of carp flesh as well as to study the effect of some methods of liquid smoke application on the quality of smoked sausage manufactured from common carp. The effect of cooking on the quality of the smoked sausage was also investigated.

MATERIALS AND METHODS

Fresh common carp fish (Cyprinus carpio) was obtained from the local market in Giza, A.R.E. The fresh fish was dressed and filleted (by removing head, fins, tail, viscera and skin. Filets were washed and fellating). Carp fish sausage was prepared by common method according to the following formulation: 70% minced fish flesh, 8% mutton fat (minced), 5% starch, 2% salt, 0.25% from each: black pepper, white pepper, red pepper, nutmeg, cardamon and garlic 0.1% from each: cumin and sugar, 0.3% sodium pyrophosphate and 13% water (as ice flakes). Liquid smoke was produced and prepared as described by Moghazy, (1994). The various liquid smoke treatments and method/ stage of application are described in Table 1.

The physical, chemical and microbiological characteristics were evaluated before and after the cooking process which was carried out by dipping the sausage units in hot water (85^{o}C) for 15 minutes, while the organoleptic evaluation was carried out only after cooking. The moisture content was determined using the meth-

Table 1. Lipuid smoke treatments, method and stage of application during fish sausage manufacturing.

Liquid smoke treatment (code)	Method of application	Stage of application
Liquid smoke-aerosol (T1)	As described by Moghazy, (1994), where liquid smoke was sprayed on sausages in air at 95°C, then rest for 3-5 min., the cycle was repeated at least 20 times till forming the golden color.	During 70°C heat cycle.
Liquid smoke-aerosol (T2)	Sausage units were dipped in a 25% liquid smoke solution at 70°C in the following manner: 20 sec. dip, 40 sec. rest; this was repeated 5 times.	Prior to heat processing.
Liquid smoke-aerosol (T3)	25% liquid smoke solution was dissolved in a part of the recipe water and added directly to the formula (at 0.4% level as an ingredient).	Near the end of chopping time
Liquid smoke-aerosol (T4)	Spices, salt, starch and mutton fat were smoked individually via spraying of liquid smoke and drying at ambient temp., the spraying and drying were repeated 5 times.	Before mixing and chopping

od described by the A.O.A.C. (1985). Total volatile nitrogen (T.V.N.) was estimated by the method of winton and winton (1958), while thiobarbituric acid value (T.B.A.), as an indication for lipid oxidation, was assessed as described by pearson (1970). Total phenols (mg/100g sample) were determined according to the method described by Bratzler *et al.*, (1969). The pH value was measured by a pH-meter according to the method of krilova and liskovskaia (1961). Water holding capacity (W.H.C.) and plasticity were measured according to the filter-press method of soloviev (1966). Cooking loss and yield % were calculated as the percentage of weight change from the raw to cooked state. As for the microbial load, twently grams of sample was homogenized and diluted in 180 ml of tryptic soy broth. Aerobic bacteria count was performed according to A.P.H.A. (1971). Aerobic proteolytic microorganisms were grown on gelatin agar medium, (Smith *et al.*, 1952) while lipolytic microorganisms were grown on the nutrient emulsified oil agar (Difico manual, 1953).

Smoked samples were organoleptically evaluated after cooking (at 85^{o}C for 15 minutes) where sausages removed from the hot water, placed in plates and then served to a panel composed of 10 members of trained panelists to evaluate the smoked samples with different methods of liquid smoke application for appearance, flavour odor, texture, color, and overall satisfaction according to Twigg *et al.*, (1976) who recommended the following judging scale: 9 = best and 1 = poorest.

Data were analysed using the analysis of variance to evaluate the effect of method of liquid smoke application on the palatability scores of fish sausage. Means were compared by using least significant difference (L.S.D.) at 0.5 level (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

A. Chemical analysis:

a. Moisture content:

Data presented in table 2 show the moisture content of common carp sausage as affected by the method of liquid smoking and cooking. It is evident that the moisture content difference between treatments was actually small and mostly negligible when the smoked samples are compared to the control sausage (not smoked); in this concern, before cooking, the moisture content was 66.20 -66.77%, while it was 65.25 -65.96% in the cooked sausages. By cooking, the moisture content declined possibly due to protein denaturation and the loss of water binding ability.

Due to cooking, thermal denaturation occurred causing some loss of moisture and accordingly shrinkage of samples, although such process was accompanied by the slight increase of pH value.

Table 2. Effect of liquid smoke treatments and cooking on moisture % of carp fish sausage.

Treatment	Before cooking		After cooking	
	g/100 g	% of change	g/100 g	% of change
Control (not smoked)	66.60	---	65.53	---
T1	66.39	-0.32	65.25	-0.43
T2	66.20	-0.60	65.33	-0.31
T3	66.77	+0.26	65.96	+0.66
T4	66.49	-0.17	65.41	-0.18

b. pH value:

Data in table 3 show the pH value of smoked sausage manufactured from common carp, as influenced by the methods of liquid smoking and cooking. It is clear that the smoked samples (T1 - T4) had lower pH value than the control due to the penetration of smoke liquid acids to sausages.

Table 3. Effect of liquid smoke treatments and cooking on the pH values of carp fish sausage.

Treatment	Before cooking	After cooking
Control (not smoked)	6.06	6.07
T1	5.18	5.32
T2	4.90	4.82
T3	5.82	5.99
T4	5.79	5.94

Cooking resulted in increasing the pH values. This was previously explained by protein denaturation (Horner, 1992). Nevertheless, for T2 sausage, slight decrease in the pH occurred. This might be attributed to the presence of much acids before cooking. The mentioned acids enhanced the hydrolysis of certain dipeptides at 85oC for 15 min to increase slightly some free amino acids, causing a very slight decrease of the pH value after cooking (by 0.08 units only). The increase of pH value in other samples may also be ascribed by the loss of organic acids in the cooking water.

Before as well as after cooking, samples could be arranged in a descending order according to their pH values as follows : control, T3, T4, T1 and T2.

c. Phenolic compounds:

The phenolic compounds contents of fish sausages as affected by the smoking method and cooking are shown in table 4. It is evident that sausages of T2 had the highest phenols before and after cooking. This indicate that such sample received higher smoke compounds than the other treatments, which was also found for acids as indicated by the pH value (Tables 3 and 4). While the control sample had lowere phenols (Table 4) and lower acids (higher pH, table .3).

It is evident that cooking decreased the phenols possibly due to their separation to the cooking water. It may be claimed that, if phenols content is taken as a quality index, the level of these compounds should be considered not only after cooking, but also before cooking to control the process.

Table 4. Effect of liquid smoke treatments and cooking on total phenols (mg/100 g sample) of carp fish sausage.

Treatment	Before cooking	After cooking
Control (not smoked)	Traces	Traces
T1	5.10	2.52
T2	5.42	2.85
T3	2.22	1.12
T4	3.31	1.68

d. Total volatile nitrogen (T.V.N.):

Data presented in table 5 show the T.V.N. of common carp fish sausage as affected by the smoking method and cooking. It seems that neither smoking method nor the cooking affected the level of T.V.N. of fish sausage. Difference between lower and higher T.V.N. values of fish sausage before cooking (15.93 - 17.30 mg/100 g) was 1.37 mg/100 g, and after cooking, (16.50 - 18.55 mg/100 g) was 2.05 mg/100 g. This indicate that differences due to treatments were extremely slight. Nevertheless, cooked samples tended to show slightly higher T.V.N. contents than before cooking, which might be ascribed to slight enhancement of low molecular weight nitrogen compounds by heating to 85°C. Within certain limits, sausage of T2 tended to show low T.V.N. before and after cooking.

Table 5. Effect of liquid smoke treatments and cooking on T.V.N. (mg/100 g sample) of carp fish sausage.

Treatment	Before cooking	After cooking
Control (not smoked)	17.30	18.55
T1	16.50	17.23
T2	15.93	16.50
T3	17.12	17.98
T4	16.81	17.72

e. Thiobarbituric acid value (T.B.A.):

Malonaldehyde content of fish sausage as affected by smoking method and cooking is presented in table 6. As for the T.V.N., the T.B.A. value did not differ according to smoking treatment or cooking ranging 0.32 - 0.61 mg malonaldehyde per Kg sausage, difference by, 0.29 mg/Kg only).

Table 6. Effect of liquid smoke treatments and cooking on T.B.A. (mg/100 g sample) of carp fish sausage.

Treatment	Before cooking	After cooking
Control (not smoked)	0.61	0.58
T1	0.58	0.40
T2	0.55	0.38
T3	0.34	0.32
T4	0.43	0.42

B. Physical characteristics:

a. Cooking loss and yield of sausage:

Data presented in table 7 show the cooking loss and yield of common carp fish sausage as affected by the smoking treatments and cooking. It could be observed that the cooking loss was 2.41% for different samples, while the cooking yield was 96.59 - 97.59% showing a differences of only 1% for both. Best cooking yield was found for T2 (97.59%), which showed also higher phenol (table 4), lower T.N.V. (table 5) and lower pH value (table 3).

Table 7. Effect of liquid smoke treatments and cooking on cooking loss and yield of carp fish sausage.

Treatment	Cooking loss %	Cooking yield %
Control (not smoked)	3.41	96.59
T1	2.71	97.29
T2	2.41	97.59
T3	3.13	96.87
T4	3.03	96.97

b. Water holding capacity and plasticity:

1. Water holding capacity (W.H.C):

Data illustrated in table 8 show the W.H.C. and plasticity of common carp fish sausage as influenced by the smoking treatments and cooking.

Table 8. Effect of liquid smoke treatments and cooking on water holding capacity (W.H.C., cm2) and plasticity (cm2/0.3 g) of carp fish sausage.

Treatment	Before cooking		After cooking	
	W.H.C.	Plasticity	W.H.C.	Plasticity
Control (not smoked)	1.7	6.2	6.3	2.9
T1	8.2	2.6	4.1	2.9
T2	9.5	2.6	3.5	2.8
T3	2.8	5.0	3.9	2.5
T4	2.9	5.9	3.6	2.6

The results of W.H.C. before cooking indicate that smoking by different methods decrease the W.H.C. from 1.7 to 2.8 -9.5, which may be ascribed to absorption of smoking liquid acids and accordingly the pH decline towards the isoelectric point of protein resulting in less water binding ability. If we consider the level of phenols table 4, as an index of smoke components, absorption including the acids (which reduce the pH and W.H.C.), it will be seen that highest phenols content (indicates indirectly possible highest absorbed organic acid and lowest pH) was found for sausages of T2 which had the lowest W.H.C. (9.5 cm2). The lowest phenols (highest pH) was found for control sample which had the best W.H.C. (1.7 cm2). After cooking, however, the view was changed. The control sample had the lowest W.H.C. compared to the smoked sausages; the reverse was noticed before cooking It seems that, during cooking, the acids in the smoked samples caused some hydrolysis of certain chemical bonds which lead to better W.H.C. Anyhow, after cooking, samples of T2 showed the best W.H.C.

2. Plasticity:

Before cooking, best plasticity was found for the control sample (6.2 cm2) when compared to the smoked sausages (2.6 - 5.9 cm2). This is possibly due to absorption of acids, which caused some loss in protein solubility. This was also recorded for W.H.C. Therefore, before cooking, plasticity seems to be affected by the W.H.C. and also the pH value. Anyway, T2 sausages in concern to plasticity was one of the best three tested treatments.

C. Microbiological aspects of fish sausage:

Data of table 9 show the total aerobic bacterial count (T.A.B.C.), lipolytic bacteria and proteolytic bacteria of fish sausage as affected by smoking method and cooking. It could be observed that before as well as after cooking, the bacterial load was higher for the control sausage, while decreased in the smoked samples, which could be ascribed by the effect of smoke components, which are lethal to sensitive microorganism (Donnelly *et al.*, 1982 and Munker and Meyer, 1994).

Table 9. Effect of liquid smoke treatments and cooking on some microbiological properties of carp fish sausage (c.f.u.*/g).

Treatment	Before cooking			After cooking		
	T.A.B.C**	L.B.***	P.B.***	T.A.B.C**	L.B.***	P.B.***
Control (not smoked)	2.0x105	2.3x104	5.0x103	3.1x104	3.5x103	7.8x102
T1	3.5x104	4.0x103	1.1x103	8.3x103	1.0x103	6.0x102
T2	1.5x104	1.0x103	9.5x102	4.0x103	9.5x102	4.5x102
T3	4.8x104	5.0x103	2.3x103	9.0x103	2.2x103	6.6x102
T4	5.0x104	7.2x103	2.8x103	9.5x103	3.5x103	7.7x102

* C.f.u = Cell forming unit. ** T.A.B.C. = Total aerobic bacteria count.
*** L.B. = Lipolytic bacteria. **** P.B. = Proteolytic bacteria.

As expected, lipolytic and proteolytic bacteria represented a small part of the total bacterial count, lipolytic and proteolytic bacteria are responsible for hydrolysis of both the lipids and protein of fish products. Therefore, smoking of fish sausages, should favor the shalf life of mentioned products. The levels of T.A.B.C., lipolytic B. and proteolytic B. were proportionally related to the smoke components absorbed in sausage. The lower the pH value (more absorbed acids) the higher the phenols content and the lower the T.A.B.C., lipolytic B. and proteolytic B. counts were found. If samples arranged in a descending order according to the level of bacteria (T.A.B.C., lipolytic B, and proteolytic B) the order obtained will be the same for arrangement of samples in a descending order according to phenols and in an ascending order for pH; this order of arrangement will be as follows for mentioned three parameters before and after cooking: control, T3, T4, T1 and T2. It is evident that cooking was an efficient treatment to cause dramatic decline of the bacteria. Moreover, T2, was the best treatment in regard to the microbiological counts.

D. Organoleptic evaluation of sausaques:

Average score for appearance, flavour, odor, texture, color and overall satisfaction of common carp fish sausages as affected by the method of smoking and cooking is shown in table 10. It could be observed that sausages of T3 and T4 were of significantly lower values for all eating qualities under investigation, only the appearance of T3 and T4 were of lower non-significant scores, compared to T1. Actually overall acceptability of sausages T3 and T4 was significantly inferior compared to T1 and T2.

In regard to the sausages of T1 and T2, the later sample was better concerning, appearance, flavour, odor, texture, color and overall satisfaction, although differences were significant only for flavour. This indicated that sausages of T2 were the best (compared to T1, T3 and T4). This treatment (T2) resulted in sausages with higher yield and phenols content, lower pH, T.V.N. and bacterial load, thereby, it is recommended for commercial production. In a separte paper, the storage stability of different treatments at different temperatures will be published.

Table 10. Organoleptic evaluation of carp fish sausage smoked with different treatments of liquid smoke application.

Treatment	Average scores*					
	Appearance	Flavor	odor	Texture	Color	Overall satisfaction
T1	7.78a,b	8.28a	8.44a	8.56a	8.05a	8.22a
T2	8.44a	8.83b	8.48a	8.78a	8.15a	8.54a
T3	6.78b	6.89c	5.89b	8.00a	6.00b	6.87b
T4	7.00b	7.06c	6.72b	8.33a	6.83b	7.02b

* Means within the same column group followed by the same letter are not significantly different (on level 0.05).

REFERENCES

1. A.O.A.C. 1985. Official Methods of Analysis. Association of official Analytical chemists 12th ed. Wahington, D.C., U.S.A.

2 . American Public Health Association (A.P.H.A.). 1971. Standard methods for the examination of water and waste water, 13th ed., 651, 664 : 665.

3 . Bratzler, L.J.; Spooner, M.E.; Weatherspoon, J.B. and Maxey, J.A. 1969. Smoke flavor as related to phenol, carbonyl and acid content of bologna, J. of Food Sci., 34, 146: 148.

4 . Difico Manual 1953. Difico manual of hydrated cultures media and reagent, 9th ed., 32. Difico Laboratories incorporated, Detroit, Michigan, U.S.A.

5. Donnelly, L.S.; Ziegler, G.R. and Acton, J.C. 1982. Effect of liquid smoke on the growth of lactic acid starter culture used to manufacture fermented sausage. J. of Food Sci., 47: 2074.

6. Gorbatova, V.M.; Krylova, N.N.; Volovinskaya, V.P.; Lyaskovskaya, Y.N.; Bazorova, K.I.; Khalamova, R.I. and Yakovleva, G.Y. 1971. Liquid smoke for use in cure meats. Food Technol., 25: 71.

7. Hassanin, M.A. 1993. Effect of some processing on the chemical compounds of some fish varieties. M. Sc. Thesis, Fac. of Agric., Ain Shams Univ., Egypt.

8. Horner, B. 1992. Fish smoking. Ancient and modern. Food Sci. and Technology Today, 6 (3): 166-171. C.F. FSTA 24 (12), R62.

9. Krilova, A.L. and Liskovshaia, U.N. 1961. Physical and chemical methods of analysis of animal products. Food Indust. Pub., Moscow.

10. Maga, J.A. 1988. Smoke in food processing, Dept. of Food Sci. and Human Nutrition, Colorado Univ., Fort collins, Colorado, U.S.A.

11. Moghazy, E.A. 1994. Studies on some fish and its products. Ph. D. Thesis, Fac. of Agric., Zagazig Univ. Egypt.

12. Munker, W. and Meyer, C. 1994. Studies on use of liquid smoke for preparation of smoked fish products. Fleischwirtschaft, 74 (5): 547-553.

13. Oluski, A. and Zinvanovic, R. 1976. Bactericidal activity of a Yugoslav smoke smoke preparation. Technol. Mean., 17 (2) : 374.

14. Pearson, D. 1970. The chemical analysis of food. National College of Food Tecnol., Univ. of Reading, Weybridge, Surry J. and Chirchill.

15. Radetic, P.M., Suvakov, M. and Panin, J.T. 1982. Effect of carbonyl and phenolic compounds of smoke on pH and water holding capacity of smoked beef. Technol. Mesa., 23: 194.

16. Shabaan, A.A. 1994. Chemical and technological studies on fish smoking. M.Sc. Thesis, Fac. of Agric. Al-Azhar Univ., Egypt.

17. Sink, J.D. and Hsul, L.A. 1977. Chemical effects of smokeprocessing on frankfurter manufacture and storage characteristics. J. of Food Sci., 42: 1489.

18. Smith, R.G.; Gordan, R.E. and Clark, F.E. 1952. Aerobic spore forming bact., U.S. Dept. Agric. Monograph., No. 16.

19. Soloviev, V.E. 1966. Meat aging. Food industry Pub. (Moscow), 53-81, 82-164.

20. Steel, R.G. and torrie, J.H. 1980. Principles and Procedures of Statistics, 2nd ed., McGraw-Hill Book Co., New York.

21. Toth, L. and Pothast, K. 1984. Chemical aspects of the smoking of meat and meat products. Adv. Food Res., 29: 87.

22. Twigg, G.; Youn, E.P. and Kitul, A.W. 1976. Evaluation of beef patties containing soy protein during 12 month frozen storage. J. of Food Sci., 41 : 1142.

23. Winton, A.L. and Winton, R.B. 1958. Okoloff magnesium oxide distillation volumetric method. The Analysis of Food, 848, John Wiley, New York and Hull, London.

24. Wistreich, H.E. 1979. The smoke house process application of liquid smoke. Food Technology, 33 (5) : 90.

خصائص جودة السجق المدخن المصنع من سمك المبروك العادى وعلاقتها بطرق التدخين السائل المختلفة والطبخ

الشحات عبد الله مغازى ، بدوى محمد درويش، طه عبد المطلب السيسى

معهد بحوث تكنولوجيا الأغذية – مركز البحوث الزراعية – جيزة – مصر.

أجرى هذا البحث للتغلب على الشعبية المنخفضة لأسماك المبروك العادى (Cyprinus carpio) والمتمثلة فى الرائحة الغير مرغوبة ووجود أشواك كثيرة فى لحم السمك. وقد تم تصنيع السجق المدخن المصنع من لحم سمك المبروك العادى كحل لهذه المشكلة. وقد أجرى تدخين سجق المبروك بأربع طرق هى T1) " المعاملة الأولى" وهى طريقة الرش T2) " المعاملة الثانية" وهى طريقة النقع أو الغمس فى محلول سائل تدخين ٢٥٪ لمدة ٢٠ ثانية T3) "المعاملة الثالثة" وهى طريقة الخلط المباشر حيث يتم خلط سائل التدخين مباشرة مع مكونات السجق و T4) " المعاملة الرابعة" وهى طريقة الخلط الغير مباشر حيث يتم الرش بسائل التدخين بصورة متكررة لكل من التوابل والملح والنشا والدهن (كل على حده) وذلك قبل تصنيع السجق. وقد تم طبخ السجق فى ماء على درجة ٨٥ ه م لمدة ١٥ ق. وقد أظهرت التحاليل فروق بسيطة جدا بين المعاملات وذلك بالنسبة للمحتوى الرطوبى باستثناء السجق الناتج عن المعاملة الثالثة والذى سجل محتوى رطوبى أعلى قليلا بغض النظر عن الطبخ الذى أدى الى انخفاض بسيط فى المحتوى الرطوبى. وقد تميزت المعاملة الثانية بإنخفاض الـ PH (٤,٨٢ – ٤,٩٠) بالمقارنة بالعينات الأخرى للمعاملة الأولى والثالثة والرابعة (٥,١٨ – ٥,٩٩) فى حين تميزت عينات الكنترول بقيمة PH أعلى (٦,٠٦ – ٦,٠٧) وذلك قبل وبعد الطبخ وقد أدت عملية الطبخ الى زيادة الـ pH للمعاملات باستثناء المعاملة الثانية. إتبعت الفينولات نفس الترتيب للأحماض العضوية فى الانسجة (كما أظهرها الـ pH الأقل) فقد كانت الفينولات أعلى فى عينات المعاملة الثانية ثم تلتها المعاملة الأولى فالرابعة فالثالثة ثم عينات الكنترول التى كانت أقلهم فى محتوى الفينولات وذلك قبل أو بعد الطبخ، وقد أدت عملية الطبخ الى فقد واضح للفينولات وذلك قبل أو بعد الطبخ ، وقد أدت عملية الطبخ الى فقد واضح للفينولات مع ماء الطبخ. كما وجد أن معاملات التدخين والطبخ لم تؤثر على النيتروجين المتطاير الكلى (T.V.N.) أو قيمة حمض الثيوبار بتيوريك (T.B.A.) لسجق السمك. الفقد بالطبخ والانتاجية إختلفت فى حدود ١ ٪ للمعاملات المختلفة. القدرة على إمساك الماء (W.H.C.) والبلاستيكية كانت عالية بصورة واضحة لسجق المعاملة الثانية والتى أظهرت أعدادا أقل من البكتريا الكلية والبكتريا المحللة للدهن والبكتريا المحللة للبروتين سواء قبل أو بعد الطبخ، وقد كانت عملية التدخين وكذلك الطبخ ذات فاعلية فى تقليل الأحمال البكتيرية. كما كانت الجودة الحسية الأفضل بالاختبار الحسى من نصيب المعاملة الثانية والتى تقترح للإنتاج التجارى.