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EFFECT OF SUGAR ON ABSORPTION OF ALUMINUM RESIDUE IN FISH

(With 5 Tables)

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تاثير السكر فى أمتصاص بقايا مادة الألومنيوم فى الأسماك

أمل على شحاته ، هاله على ، أمانى هيما

ازداد استخدام الألومنيوم فويل فى حفظ وشوى الأطعمة ومنها الأسماك ونظراً لما له من تأثير ضار على الصحة العامة فقد اجريت هذه الدراسة بغرض محاولة تقليل هجرة عنصر الألومنيوم من الألومنيوم فويل الى الأسماك باستخدام مادة طبيعية لا تؤثر على طعم الأسماك ولا تسبب وجود بقايا ضارة به مثل السكر وذلك على النحو التالى حيث تم تقسيم العينات الى اربع مجموعات مجموعة أولى: بدون تتبيل وبدون تغليف بورق الألومنيوم ومجموعة ثانية: بدون تتبيل ومغطاة بورق الألومنيوم ومجموعة ثالثة: متبلة بالملح والليمون والثوم والبصل والطماطم ومغطاة بورق الألومنيوم ومجموعة رابعة: متبلة ومغطاة بطبقة من السكر ومغطاة بورق الألومنيوم. أوضحت النتائج إحتواء الأسماك التى تم شويها فى ورق الألومنيوم على نسبة عالية من عنصر الألومنيوم وخصوصا الجلد. كذلك وجد أن إضافة الملح والليمون والثوم والبصل والطماطم الى السمك أدى الى زيادة هجرة عنصر الألومنيوم من ورق الألومنيوم إلى الأسماك بينما أدت إضافة السكر الى تقليل هذه النسبة.

SUMMARY

The effect of sugar on absorption of aluminum (Al) residue in Tilapia was studied. This work was carried out on 28 random tilapia fish samples. Samples were divided into four groups (seven for each group) where the 1st group fish were grilled without additives and without wrapped with aluminum foil while the 2nd group, fish were grilled without additives but wrapped with aluminum foil. The 3rd group, fish were grilled with adding salts, onion, tomato, garlic and lemon, then wrapped with aluminum foil, while the 4th group, fish were grilled with adding salts, onion, tomato, garlic and lemon, then 5% sugar from weight of fish were spread on the whole fish surface and wrapped with

aluminum foil. Samples were grilled in oven at 180°C for 20min. Each sample was divided into 2 parts; skin and muscle. The results showed that the highest level of aluminum residue in fish grilled with addition of salts, onion, tomato, garlic and lemon, while addition of sugar reduced migration of aluminum into the skin and muscle of fish.

Key words: *Fish, aluminum residue, aluminum foil, sugar.*

INTRODUCTION

Fish is considered one of the most important food stuffs, they are the cheapest source of animal protein in many countries. Fish have protein of high biological values as they contain essential amino acids and good source of minerals such as calcium, phosphorus, iron and trace elements like Iodine, as well as, vitamins, in addition to the content of polyunsaturated fatty acid (Sedik *et al.,* 1989)

Aluminum is widely used for manufacturing household utensils and packaging materials. Aluminum foil is widely used for packing, storing and cooking of various foods. Especially, it is common practice to wrap meat and fish and grill or cook them in the oven in order to prevent water up take (McWilliams, 1989) and avoid direct heat (Ranau *et al.,* 2001). The widespread use of aluminum foils makes them a significant potential source of dietary aluminum.

The extent of the increase of aluminum is dependent on several factors such as PH of the food and/or cooking medium, temperature, duration of contact or heating, presence of sugar, organic acids, salts and other ions (Ranau *et al.,* 2001).

Aluminum toxicity is well known in patients with long standing chronic renal failure (Meiri *et al.,* 1993), aluminum has also been associated with several skeletal osteomalacia and neurological failures e.g; Alzhemier's disease (Gauthier *et al.,* 2000; Rondeau *et al.,* 2000; polizzi *et al.,* 2002; Miu *et al.,* 2004; Gupta *et al.,* 2005).

Regarding the suggested provisional tolerable daily intake of 1mg Al/Kg body weight per day of the FAO/WHO Expert Committee on food additives (FAO/WHO, 1994), it can be stated that there is no evident risk to health of consumer. However, it is possible that excessive consumption of foods packed with aluminum foil may carry a health risk.

In recent years, it is common practice to wrap the meat and fish prior to oven cooking. Due to possible relation between aluminum uptake and the specific diseases mentioned above, it is important to determine the aluminum concentration of food wrapped with aluminum. This study was conducted to detect the levels of aluminum content in fish packed with aluminum foil and grilled in oven and try to decrease the migration of aluminum to fish by using sugar.

MATERIALS and METHODS

A total of 28 samples of fresh Tilapia fish were collected randomly from shops at Giza-Egypt. Samples were transferred under strict hygienic measures to laboratory as soon as possible where they were subjected to suitable preparation.

Samples were divided into four studies (seven for each study), 1st study, fish were grilled without additives and without wrapped with aluminum foil, 2nd study, fish were grilled without additives but wrapped with aluminum foil, 3rd study, fish were grilled with addition of salts, onion, tomato, garlic and lemon, then wrapped with aluminum foil, 4th study, fish were grilled with addition of salts, onion, tomato, garlic and lemon. Five percentage of sugar from weight of fish were spread on fish surface and wrapped with aluminum foil. Samples were grilled in oven at 180°C for 20min. Each sample was taken from 2 parts; skin and muscle.

Each sample was minced and homogenized then analyzed for aluminum content by wet oxidation method, according to AOAC (1990) by using a Perkins Elmer 2380 Atomic Absorption Spectrophotomter at wave length 309, temp. 2900-3000^{0}C with nitrous oxide and acetylene.

The data obtained from four groups were analysed by one –way ANOVA using the SPSS statistical package program, and difference among the individual means were compared using LSD range test (SPSS, 2007).

RESULTS

Table 1: Level of aluminum content (ppm) in 1st group (fish grilled without additives and without wrapping with aluminum foil):-

Samples	MIN	MAX	Mean±SE
Skin	0.18	0.982	0.646± 0.1
Muscle	0.112	0.395	0.179 ± 0.03

Table 2: Level of aluminum content (ppm) in 2nd group (fish grilled without additives but wrapped with aluminum foil):-

Samples	MIN	MAX	Mean±SE
Skin	0.101	0.26	0.160 ± 0.02
Muscle	0.09	0.21	0.158± 0.01

Table 3: Level of aluminum content (ppm) in 3rd group (fish grilled with addition of salts, onion, tomato, garlic and lemon and wrapped with aluminum foil):-

Samples	MIN	MAX	Mean±SE
Skin	0.816	3.53	1.731± 0.36
Muscle	0.332	0.713	0.560 ±0.06

Table 4: Level of aluminum content (ppm) in 4th group (fish grilled with addition of salts, onion, tomato, garlic, lemon with spreading of sugar on surface of fish and wrapped with aluminum foil):-

Samples	1st group	2nd group	3rd group	4th group
Skin	0.160 [a]	0.646 [b]	1.731 [c]	1.401 [d]
Muscle	0.158 [a]	0.179 [a]	0.560 [b]	0.308 [c]

Table 5: statistical analysis

Samples	MIN	MAX	Mean±SE
Skin	0.51	2.19	1.401± 0.25
Muscle	0.202	0.514	0.308± 0.04
Samples	MIN	MAX	Mean±SE
Skin	0.51	2.19	1.401± 0.25
Muscle	0.202	0.514	0.308± 0.04

No significant difference (P<0.05) between cells contain same letter in the same row.

DISCUSSION

The obtained results showed the migration of aluminum from aluminum foil to skin of fish more than the muscle due to the skin was directly contact to aluminum foil. Table 1 revealed that the mean values of aluminum contents in fish (skin and muscle) grilled without additive and without wrapping with aluminum foil were 0.160 ± 0.02 and 0.158± 0.01 ppm; respectively.

The results in Table2 showed the mean values of aluminum content in 2 nd group, fish were grilled without additives but wrapped with aluminum foil in skin and muscle were 0.646± 0.1 and 0.179 ± 0.03ppm; respectively. Significant differences was showed as increasing in aluminum residues in skin of fish in the 2 nd group at (P<0.05), while no significant differences at (P<0.05) between muscles in 1st group and 2 nd group due to migration of aluminum from aluminum foil into fish skin and muscle during grilled which increase by temperature. Other researches stated that cooking in aluminum utensils or aluminum foil increased the aluminum concentration of foods (Ranau *et al.*, 2001; El-Zeini and Hosny, 2003; Diab, 2005; Turhan, 2006; El-Mossalami and Noseir, 2009; Mohamed and Noiser, 2009).

The level of aluminum content in 3rd group, fish grilled with addition of salts, onion, tomato, garlic and lemon then wrapped with aluminum foil were shown in Table 3. The mean value of aluminum content in skin and muscle were 1.731± 0.36 and 0.560±0.06 ppm; respectively. the results were agreed with Gramiccioni *et al.* (1996); Diab (2005); El-Tabiy (2010). From this result, it is evident that

significant increased in skin and muscles of fish grilled in the 3rd group at ($P<0.05$) as compared with the 2nd group Table 5. From the present data, it could be concluded that acidic and salted foods increased the migration of aluminum into foods as a result of enhancing chemical and/or electrochemical corrosion. Shuping (1996) reported that aluminum concentration increased due to chemical corrosion by acids and alkalis during boiling and storage for short periods. Takeda *et al.* (1998) reported aluminum migration from aluminum pan into foods increased by increase temperature and addition of acidic foods (including orange and tomato juice, yoghurt and different types of pickles and vinegars) but was reduced by presence of proteins, amino acid, sugar or cholesterol.

Table 4 showed the Level of aluminum content in 4th group, fish that grilled with addition of salts, onion, tomato, garlic and lemon, then 5% sugar from weight of fish were spreaded on the whole fish surface and wrapped with aluminum foil in skin and muscle were 1.401± 0.25 and 0.308± 0.04ppm; respectively. From Table 5, it is evident that significant decreased in skin and muscles of fish grilled in the 4th group at ($P<0.05$) as compared with 3rd group, this may be attributed to that the level of aluminum migration from aluminum foil was reduced by addition of sugar. The hypothesis reported by Takeda *et al.* (1999) who stated that the level of aluminum migration from thick aluminum foil to chicken meat samples, and the addition of molasses which considered as a source of sugar decreasing the migration of aluminum from aluminum foil to food. These data are agreement with those reported by GabAlla (1998) who repoted that the migration of aluminum from an aluminum pan into food was greater compared with stainless steel. Acidic and salty foods caused greater migration of aluminum into the foods during cooking, while addition of sugar reduced migration of aluminum into the foods. Also, El-Zeini and Hosny (2003), reported that, covering chicken meat samples with molasses before wrapping in thick aluminum foil, resulted in decreasing aluminum migration in the chest and thigh muscles by (7-5%) respectively, if compared with non molasses covered meat wrapped in thin (67-30%) and thick (40-21%) aluminum foils respectively.

It could be concluded after estimation of aluminum residue in each of the four grilled fish groups that the fish group grilled without aluminum foil wrap was the best one concerning the aluminum residue

followed by fish group that grilled with aluminum foil warp and sugar addition.

The group of fish that grilled using aluminum foil with additives was the least one. It was also concluded that spreading of sugar on surface of fish has successfuly decreased aluminum migration from aluminum foil to fish.

On the other hand it is recommended to either remove the skin of fish after grilling or spreading sugars along the fish surface in condition of eating fish grilled with aluminum foil.

FAO/WHO Expert Committee on food additives (FAO/WHO, 1994), conclude that the daily intake of aluminum in children is 2-6mg/Kg and in adults 6-14mg/Kg. Regarding the body weight (WHO, 1989) suggested tolerable daily intake of 1mg/Kg body weight and there is no evident risk to health of consumer from eating 200mg daily of cooked meat prepared by aluminum foil.

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