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Risk Assessment of Using Aluminum Foil in Food Preparation

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Abstract

In this investigation, leaching of aluminum from aluminum foil in different food samples (red meats and chicken) was studied. The effect of cooking treatments (temperature and time of cooking) on aluminum contents of food samples baked in aluminum foil was evaluated. Cooking increased the aluminum concentration in both samples under investigation. The highest increase was in chicken sample baked for 20 min at 250C° . It was also found that the acidic content of chicken sample in addition to the cooking process affected the migration of aluminum. Excessive consumption of aluminum from leaching aluminum foil has an extreme health risk effects. Aluminum foil may be used for packing but not for cooking.

Key words: Aluminum foil; Cooking Red meat; Chicken. ICP-MS

1. Introduction

Aluminum (Al) is nonessential element to humans ,although it is one of the most common elements in our environment, comprising almost 8.8% of the earth crust (88,000 ppm).Aluminum is not only the light silvery metal used to make pots, pans, airoplanes; beverage cans and foil, but also has non metallic form which found everywhere. Aluminum compound is used in many diverse and important industrial applications such as alums (Aluminum sulfate) in water treatment and alumina in abrasives and furnace lining. They are found in some consumer products such as antacids, astringents, buffered aspirin, food additives, antiperspirants, as emulsifying agent in many processed cheeses, especially those which are single-sliced and as anti- caking agent in dried milk. Aluminum occurs naturally in soil, water and air. It is redistributed or moved by natural and human activities. Level of aluminum in the air generally ranges from 0.005 to 0.18μg/m^3. Most of aluminum in the air is in the form of small suspended particles of dust[1-6].

Minimal exposure to aluminum isn't a problem; our bodies can excrete small amounts very efficiently, a tolerable daily intake (TDI) for aluminum of 1mg/kg body weight/day has been established by an international committee of experts under the auspices of the world Health Organization (WHO) and Food and Agricultural Organization (FAO) of the United Nations[12]. Unfortunately, most of us are exposed to and ingest far more aluminum than our bodies can handle also relative deficiency of aluminum antagonists in the diets such as calcium and iron may increase the accumulation of this toxic mineral[7].

– These are a strong connection between aluminum and Alzheimer's syndrome. Research clearly demonstrated abnormally high accumulations of Aluminum within the brains of Alzheimer's patient. Independent studies performed in Norway, the United Kingdom, France and Canada; showed a direct correlation between the prevalence of Alzheimer's syndrome and Aluminum concentration in drinking water. Besides Alzheimer's, toxic levels of Aluminum has also been associated with Parkinson's disease .Chronic Aluminum exposure has contributed directly to hepatic failure and dementia. Other symptoms that have been observed in individuals with high internal concentrations of Aluminum are colic, convulsions, esophagitis, gastroenteritis, kidney damage, liver dysfunction, loss of appetite, loss of balance, muscle pain, psychosis, shortness of breath, weakness, fatigue and birth defects in new born[1].

Nowadays, it is a common practice to wrap meat and fish prior to oven cooking. Due to the possible relation between aluminum uptake and the specific diseases mentioned in many literatures, it is important to determine the aluminum concentration in the food wrapped with aluminum foil[11]. The aim of this research is to detect leaching levels of aluminum from aluminum foil in different food samples during cooking and in presence of different additives[8-10].

2- Experimental

2-1 *Apparatus :*

Inductively coupled plasma-mass spectrometry (ICP-MS)

2-2 *Materials*

- Food samples (chicken- red meat) were purchased from a local market in Najran, K.S.A.
- Spices and ascorbic acid (Sigma).
- Natural vinegar (Goody).

2-3 *procedure*

- Fresh food sample (chicken- red meat) was cutting small pieces and divided into portion
- First portion (about 200g.) was wrapped in Aluminum foil (30× 30cm), thickness 12 μm, and backed in an electrical oven at 150 °C for 1 hr.
- Second portion was wrapped in Aluminum foil and backed at 200 °C for 40 min.
- Third portion was wrapped in Aluminum foil and backend at 250 °C for 20 min.
- All portion steps were repeated a second time with addition of spices, ascorbic acid and vinegar severally.
- The cooked samples were ground in a porcelain mortar to ensure homogeneity and representative samples taken for analysis[11-13].
- An accurately weighed 3g. of cooking samples after ground was dried for 4 hrs . This process

was repeated, if necessary, until a white ash was obtained. The ash was digested in 5ml of 2M HNO_3 by boiling for about two min. and then cooling to room temperature. The cooled solution was filtered through whatman filter paper(No .41) and made up to 25ml with 2M HNO3. The clear solution was then analyzed for Aluminum by ICP.MS.

Table 1. Aluminum contents in baked red meats and chicken wrapped in aluminum foil

Food sample	Aluminum mg/kg		
	Heating temp °C / time of heating (min)		
	150 °C/60min	200 °C/40min	250 °C/20min
Red meats	29.9 ± 3.08	37.08 ± 2.65	48.05 ±3.52
Chicken	38.23 ± 2.30	42.14 ± 1.63	59.99 ±3.11

Values are means ±SE of three replicats.

Table 2. Effect of different additive on aluminum leaching during cooking

Aluminum mg/kg	additives	Conditions C°/min	Red meats	Chicken
	Spices	150°C/60 □	31.5	39.5
		200°C/40 □	39.9	44.2
		250°C/20 □	49.2	62.01
	Ascorbic acid	150°C/60 □	33.7	41.82
		200°C/40 □	43.03	47.35
		250°C/20 □	53.61	65.92
	Vinegar	150°C/60 □	35.8	45.25
		200°C/40 □	46.2	50.31
		250°C/20 □	57.92	69.52

3 Results and Discussion

Aluminum contents for baked red meat and chicken wrapped in aluminum foil are given in Table 1. Aluminum values are given in mg/kg dry weight. The aluminum content in red meat increased with increase cooking temperature from 150 °C TO 250 °C. Similar results were obtained in baked chicken increase temperature of cooking up to 250 °C will increase value of aluminum reach to 59.99 mg/ kg. These results suggest that cooking temperature is more important in aluminum leaching than cooking time. This may be explained that the higher cooking temperature stimulated the leaching of aluminum from foil to meats and chicken because at elevated temperature the oxide layer becomes thicker and change from an amorphous to a crystalline structure[8]. The leaching of aluminum foil in meats and chicken was higher in presence of different additive during cooking present in Table 2. From the results, it is clear that the leaching of aluminum foil in food samples which contain vinegar solution. With cooking temperature up to 250 °C was higher (57.92, 69.52 mg/kg) for meat and chicken[6-13].

5. References

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