

## Short Communication

# Malondialdehyde levels of frozen fish, chicken and turkey on sale in Benin City markets

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**75 samples of frozen turkey, chicken and fish sold in Benin City markets, Nigeria were screened for lipid peroxidation by colorimetric estimation of their malondialdehyde (MDA) contents. All samples contained extremely high levels of MDA. The order of MDA profiles was fish > turkey > chicken. MDA levels within chicken and turkey samples varied from market to market, while values for each of the 5 fish species studied were fairly comparable. Highest levels of MDA were obtained in oily fishes, *Trachurus trecae* and *Scomber scombrus*. These results and their likely implication for consumer health are discussed in relation to the well-known mutagenic and cytotoxic effects of MDA.**

**Key words:** Frozen storage, turkey, fish, chicken, malondialdehyde, cancer.

## INTRODUCTION

Lipid peroxidation is a major problem in the food industry. It leads to quality deterioration, rancidity and accumulation of potentially toxic compounds in foods (Gorelik et al., 2008; Paniangvait et al., 1995; Ladikos and Lougovois, 1990; Ahn et al., 1992). One of the methods of food preservation in the food industry is freezing (USDA, 2005). Paradoxically, freezing appears to have very little inhibitory effect on lipid peroxidation. Indeed studies have shown that cold preservation leads to time-dependent increases in accumulation of lipid peroxidation products (Abdel-Kader, 1996; Rey et al., 2001; Zaborowski et al., 2001). Malondialdehyde (MDA) is the major and perhaps the most studied toxic by product of polyunsaturated fatty acid peroxidation (Del-Rio et al., 2005). Several deleterious effects of MDA have been reported. Exposure to MDA induces intracellular oxidative stress leading to membrane lesions in erythrocytes (Tesoriere et al., 2002). MDA is also genotoxic, reacting with DNA to form highly mutagenic adducts in human cells (Cline et al., 2004; Del-Rio et al., 2005; Riggins and Marnett, 2001). Results from animal investigations and biochemical studies indicate that ingestion of lipid peroxo-

duction products increases frequencies of tumor and atherosclerosis (Esterbauer, 1993). Thus consumption of MDA-tainted foods may pose serious health risks.

Imported frozen fish, chicken and turkey have become regular features of Nigerian diets, even amongst the affluent. Since freezing is associated with MDA accumulation, it is important to ascertain the MDA contents of these popular food products sold in Nigerian markets. This investigation was therefore carried out to determine the levels of MDA in popular brands of frozen fish, chicken and turkey sold in some Benin City markets.

## MATERIALS AND METHODS

### Sample collection

Samples of frozen fish, chicken and turkey were purchased from retail outlets in each of 5 centrally-located and well-patronized markets in Benin City, Nigeria. The fishes comprised 5 very popular types – *Lutjanus dentatus*, *Pseudotolithus senegalensis* (cassava croaker); *Scomber scombrus*, *Scomber japonicus* and *Trachurus trecae*. On the whole, 5 samples were collected for each fish type that is, one sample/fish/market. For chicken and turkey, 5 samples each were taken from each of the 5 markets studied. The chicken, turkey and fish samples were put in separate bags and embedded in ice packs. In addition, unrefrigerated samples were taken from freshly-dressed chicken and turkey, as well as freshly-caught fish (*Tilapia zilli*). All samples were analyzed within a few hours after collection.

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### Analysis of samples for MDA

MDA levels were determined colorimetrically using thiobarbituric acid according to the method of Buege and Aust (1978). 1 g of muscle tissue (fish or meat) was finely ground in a hand mortar with acid-washed sand and homogenized with 50 ml of physiological saline for 15 min. The homogenate was centrifuged at 8,000 g for 5 min. 1 ml of the supernatant was added to 2.0 ml of trichloroacetic acid-thiobarbituric acid- HCl reagent, and the solution was mixed thoroughly. The mixture was then placed in a boiling water bath for 15 min. On cooling, the protein precipitate was removed by centrifuging at 10,000 g for 5 min, and the absorbance of the clear supernatant fraction was read at 535 nm against reagent blank. MDA values were calculated using molar extinction coefficient, and expressed as mm/g of fresh weight.

### RESULTS AND DISCUSSION

Table 1 shows MDA profiles of 5 species of frozen fish, while Table 2 depicts MDA levels in turkey and chicken in the five markets sampled. Values range from 101 – 142, 48 - 73 and 27 - 51 mmoles MDA/g fresh weight for fish, turkey and chicken respectively; with fish having 1.90 - 5.25 and 1.38 - 2.95 times higher MDA than chicken and turkey respectively. Within the turkey and chicken samples, MDA levels varied from one market to the other. Although the MDA values in the 5 fish species were comparable within fish species, the highest MDA levels were seen in *S. scombrus* and *T. trecae*. All the unrefrigerated samples collected from freshly-dressed turkey, chicken and fish had no detectable MDA.

Although MDA is a highly toxic aldehyde, there appears to be no direct data in the literature on its oral LD<sub>50</sub> values in humans or experimental animals. However studies have shown that exposure of human erythrocytes to a very low concentration (50  $\mu$ molar) of MDA brought about early redox impairment, leading to depletion of reduced glutathione, glucose-6-phosphate dehydrogenase and oxygenated hemoglobin (Tesoriere et al., 2002). The least concentration of MDA obtained in this study was 27 mmoles/g fresh weight of chicken. This is equivalent to 27,000  $\mu$ molar MDA/g. Thus if an adult human consumes 100 g of frozen muscle in a meal, this would amount to an oral exposure of 2,700,000  $\mu$ molar of MDA, a very high dose indeed. Consequently, it can be reasonably concluded that the frozen meat and fish samples analyzed have very unacceptable levels of MDA. In contrast, MDA was not detected in samples collected from fresh fish and freshly-dressed chicken and turkey. This clearly demonstrates that the MDA seen in frozen samples was due to cold storage. Studies have shown that cold storage increases lipid peroxidation and thiobarbituric acid – reactive substances in food (Abdel-Kader, 1996; Wills et al., 2004; Hernandez et al., 1999). Ingestion of foods containing lipid peroxidation products increases risks of cancer and cardiovascular diseases (Esterbauer, 1993). Thus consumption of frozen fish, turkey and chicken may have serious implications for public health in Nigeria. Imported frozen fish and meat

**Table 1.** MDA levels in 5 species of frozen fish from 5 markets in Benin City (mmoles/g fresh wt).

Fish	MDA content
<i>Lutjanus dentatus</i>	105 $\pm$ 21
<i>Pseudolithus senegalensis</i>	104 $\pm$ 17
<i>Scomber scombrus</i>	142 $\pm$ 27
<i>Scombia japonicus</i>	101 $\pm$ 18
<i>Trachurus trecae</i>	138 $\pm$ 14

Each value is mean  $\pm$  S.E.M. of values from the 5 markets sampled.

**Table 2.** MDA contents of frozen chicken and turkey sampled from 5 markets in Benin City (mmoles/g fresh wt).

Source/market	Chicken	Turkey
Market 1	37 $\pm$ 9	68 $\pm$ 13
Market 2	27 $\pm$ 5	51 $\pm$ 10
Market 3	51 $\pm$ 7	73 $\pm$ 15
Market 4	40 $\pm$ 11	48 $\pm$ 8
Market 5	36 $\pm$ 8	64 $\pm$ 10

Each value is the mean  $\pm$  S.E.M. of values for 5 different samples from one market.

became popular in Nigeria in the early 1970s, shortly after the civil war. Before that period, fresh meat, fresh fish (or smoked fish) and game formed the major protein sources for Nigerian families. Incident of cancer and cardiovascular diseases which were uncommon then, have become rather rampant (Thiam et al., 2006). This may have a direct causal relationship with altered dietary habits in Nigerian homes, offices, parties and public places, where attention has over the years shifted to frozen fish, chicken and turkey as cheaper and readily-available alternatives to the fresh and more expensive varieties.

The high MDA contents of the fish and meat samples may be a consequence of prolonged refrigeration. Imported frozen turkey, chicken and fish may take several months to reach the Nigerian consumer due to time used in importation, clearing, distribution and retailing. This period exceeds by far the USDA - recommended safe time limits for refrigeration *viz* 1 - 2 days (fresh fish and turkey) and 3 - 5 days (chicken) (USDA, 2005).

In view of the toxic effects of MDA and its implications for public health, this study underscores the need for stricter government regulation on the quality of imported meat and fish sold in Nigerian markets.

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