

Changes in Malonaldehyde Content of Some Roasted Legumes

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ABSTRACT

The effect of roasting alone or steeping of grains before roasting on malonaldehyde (MDA) contents of some legumes was investigated. The legumes studied were Beni seed (*Sesamum indicum*), African bread fruit (*Treculia Africana*), Cowpea (*Vigna unguiculata*), Ground bean (*Vigna subterranea*), Ground nut (*Arachis hypogea*), Local yam bean (*Stenostylis stenocarpa*), Locust bean (*Cerotonia siliquia*), and Soy bean (*Glycine max*). Roasting alone prior to steeping significantly ($p \leq 0.05$) increased the MDA contents in all the legumes. This increase ranged from $8.79 \pm 4.29\%$ in cowpea-Ife brown to $140.20 \pm 56.84\%$ in cowpea L-25. Steeping before roasting resulted in a significant decrease in MDA contents in the legumes ranging from $33.02 \pm 14.14\%$ in Beni seed to $63.11 \pm 32.39\%$ in cowpea L-25. These findings indicate that steeping before roasting may be a safer and more desirable way of processing these legumes given the growing reports about mutagenicity and carcinogenicity of MDA in animal models.

Keywords: Legumes, roasting, steeping, malonaldehyde.

INTRODUCTION

In Africa, especially in Nigeria, traditional processing methods such as roasting constitute a major process of food preservation. In most cases cereals and grains are harvested sun-dried and roasted. They may be used as snacks or ground for the preparation of various porridges. Research evidence has shown that legumes constitute a major source of dietary proteins in Africa (Onuorah *et al*, 1989). Legumes have relatively higher lipid levels than most other food classes (Apata and Ologhobo, 1994). During storage lipids contained in these legumes may undergo lipid peroxidation. One of the products of lipid peroxidation has been shown to be malonaldehyde (MDA) ($\text{CHO CH}_2 \text{CHO}$) is a major decomposition product of peroxidized polyunsaturated fatty acids (Shambergher, Shambergher and Wills, 1977).

Interest in the possible significance of malonaldehyde to human health has been stimulated by reports that it is mutagenic (Mukai and Goldstein, 1976, NIOSH, 2005) and carcinogenic (Spalding, 1998). Brooks and Klamerth (1968) reported that MDA reacts with deoxyribonucleic acid (DNA) indicating a possible rationale for its mutagenic effects. Further evidence that MDA could be mutagenic was provided by Mukai and Goldstein who demonstrated that MDA forms cross-links with amino groups of DNA through a Schiff base. MDA-deoxyguanosine adducts have been detected in human liver by Chaudhary *et al* (1994). The major adduct formed with DNA is the highly fluorescent cyclic N-1,N-2 malonaldehyde-

deoxyguanosine -MDA (Singh *et al*, 2001). The MDA adduct formed has a potential to ultimately lead to liver carcinogenesis.

The aim of this study was to identify processing methods by which MDA contents of legumes could be reduced making them safer for human consumption. In this report the scope covers the comparative effect of (i) roasting or (ii)steeping before roasting on the MDA content of nine legumes.

MATERIALS AND METHODS

Plant Materials

Beni seed (*Sesamum indicum*), African bread fruit (*Treculia africana*), Cow pea-Ife brown and L-25 (*Vigna unguiculata*), Ground bean (*Vigna subterranea*), Ground nut (*Arachis hypogea*), Local yam bean (*Stenostylis stenocarpa*), Locust bean (*Cerotonia siliquia*), and Soy bean-TGX 1448 (*Glycine max*) were obtained from International Institute for Tropical Agriculture (IITA), Ibadan, Nigeria and Ahmadu Bello University Agricultural Centre (National Seeds) Zaria, Nigeria.

Treatment

Raw Samples

The seed samples obtained were cleaned by winnowing of their chaff and freed of stone and other impurities.

Roasting

Stone-free and clean samples were placed in an oven and heated to 110°C for 24hrs. The samples were milled and packaged in air-tight containers.

Steeping and Roasting

Clean samples of the grains were soaked in dis-

tilled water (1:2 grain to water v/v) for 24hrs. During steeping the water was changed every 6hrs to avoid microbial growth. The steeped grains were drained and placed in oven. They were heated to 110°C for 24hrs. These grains were termed steep-roasted samples.

Determination of MDA Content of Legumes

Malonaldehyde contents of raw, roasted, and steep-roasted samples were determined by the thiobarbituric acid (TBA) method as modified by Heath and Packer (1968). Ground sample (0.25g) was homogenised in 5ml of 0.1% trichloroacetic acid (TCA). The homogenate was centrifuged at 10,000g for 5mins. An aliquot of the supernatant (1.0ml) was mixed with 4.0ml of 20% TCA containing 0.5% TBA. The mixture was heated for 30mins and then quickly cooled in an ice bath. It was then centrifuged at 10,000g 10mins. The absorbance of the supernatant was read at 532nm and value for non-specific absorption was also read at 600nm and subtracted. The MDA was calculated from a standard curve constructed using the MDA derivative 1,1,3,3-tetra methoxypropane which hydrolyses under acid conditions to form free dialdehyde.

Analysis of Data

Treatment data were subjected to analysis of variance (ANOVA) and significant differences among treatment means were obtained at 0.05 probability level. The analysis was carried out using Genstat Discovery Edition 1.

RESULTS AND DISCUSSION

Fig 1 shows the malonaldehyde contents of raw,

Table 1. Percentage increase /decrease in Malonaldehyde contents($\mu\text{g/g}$) of processed

Legume	Raw	Roasted (% \uparrow)	Steep-Roasted (%)
Beni seed	2.76 \pm 0.15	3.98 \pm 0.15 (44.84 \pm 12.94)	1.84 \pm 0.29(-) 33.02 \pm 14.14)
Bread fruit	6.63 \pm 0.14	7.45 \pm 0.15 (12.42 \pm 4.53)	4.29 \pm 0.87(-) 35.50 \pm 11.75)
Cowpea-Ife Brown	3.47 \pm 0.00	3.78 \pm 0.15 (8.79 \pm 4.29)	2.25 \pm 0.29(-) 35.30 \pm 11.75)
Cowpea- L25	1.23 \pm 0.29	2.86 \pm 0.00 (140.20 \pm 56.84)	0.41 \pm 0.29(-) 63.11 \pm 32.39)
Ground bean	3.17 \pm 0.43	3.88 \pm 0.29 (22.81 \pm 7.80)	1.64 \pm 0.29(-) 48.49 \pm 2.14)
Ground nut	1.94 \pm 0.14	2.55 \pm 0.14 (31.53 \pm 2.30)	0.92 \pm 0.43(-) 53.53 \pm 18.84)
Local yam bean	1.94 \pm 0.14	2.55 \pm 0.14 (31.53 \pm 2.30)	0.92 \pm 0.43(-) 53.53 \pm 18.84)
Locust bean	3.47 \pm 0.00	4.07 \pm 0.29 (17.73 \pm 8.35)	2.25 \pm 0.29 (35.30 \pm 8.36)
Soybean – TGX 1448E	4.70 \pm 0.29	5.21 \pm 0.15 (10.98 \pm 3.69)	2.25 \pm 0.29 (51.90 \pm 9.15)

roasted and steep-roasted legume samples, while Table 1 shows the percentage increases or decreases following roasting (only) and steeping before roasting.

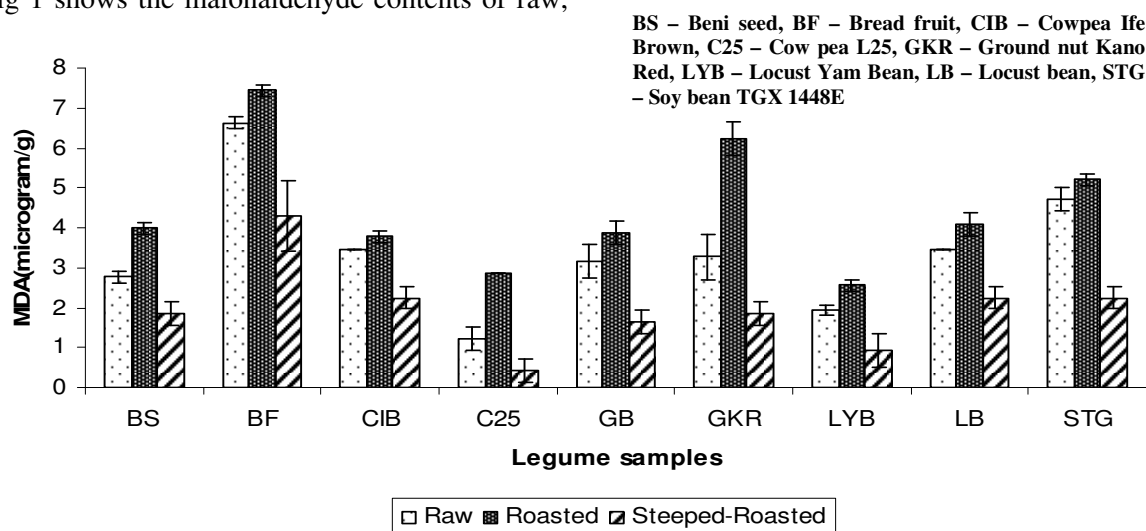


Fig 1: MDA content of raw, roasted and steeped-roasted legumes