**BAP -18**

## Influence of Varying Boiling Periods on the Chemical Composition of Coffee Senna (*Senna occidentalis*) Seeds

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**Abstract**
The effects of varying boiling periods on the proximate composition, amino acid and level of anti-nutritional factors of coffee Senna (*Senna occidentalis*) seeds were determined. *Senna occidentalis* seeds were divided into five (5) representative samples of 200 g each. The first sample was left unprocessed (raw) while the second, third, fourth and fifth samples were boiled for 30, 40, 50 and 60 minutes, respectively. Each representative sample was properly sun-dried, milled and analysed. Each sample was analysed in triplicates for the proximate composition, amino acid profile and levels of anti-nutritional factors using standard laboratory procedure. The different boiling periods were observed to significantly ($p<0.05$) reduce the proximate composition, amino acid and level of anti-nutritional factors. Boiling at 60 minutes recorded the highest level of reduction in crude protein, methionine, lysine, tannins and oxalates were observed to reduce by 3.57, 0.37, 1.79, 2.25 and 1.50 g/100 g in TI (0 minutes) to T5 (60 minutes), respectively. It can be concluded that subjecting *Senna occidentalis* seeds to boiling period of up to 60 minutes is effective in the detoxification of the seeds with relatively less depreciation in the nutritional value of the seeds. It is concluded that *Senna occidentalis* seed can be boiled up to 60 minutes without much depreciation in nutritional values.

**Keywords:** Varying boiling periods, lesser-known legumes, detoxification, *Senna occidentalis*

### Introduction

Non-ruminant animal such as poultry, rabbits and pigs are among the species of livestock that have the potentials to address the protein malnutrition prevalent in the third world Countries. However, effective production of this livestock species has been hampered by the scarcity and high cost of conventional feed resources. This was further buttressed by Bawa *et al.,* (2007) who reported that increasing unavailability and the high cost of conventional feedstuffs is one of the major problems facing the livestock industry in Nigeria. Studies have shown that lesser known legumes together with other conventional legumes can be used to address the feed/food crises in developing countries (Doss *et al*., 2011). In this regard, there is an equally perpetual effort by researchers to determine the suitability of alternative plants to serve as a source of protein, energy and other nutrients for monogastric animals (Shaahu *et al*., 2010a; Shaahu *et al*., 2010b). The target materials therefore, are those that are either unsuitable for human consumption or that have a very low human preference and are very cheap (Shaahu *et al*., 2015). One of such alternative wild legume that can be exploited as feed material is coffee Senna (*Senna occidentalis*) seeds.

*Senna occidentalis* is a wild legume that belongs to the family *Leguminosea caesalproideae.* It is an erect hairless shrub that grows up to 100 cm high and produces from seeds. The leaves are compound, pinnate, alternate and 10-15 cm long. The inflorescence is an axillary raceme with yellow flowers (Akobundu and Agyakwa, 1998). Augustine *et al.* (2014) reported that the seeds contain anti-nutritional factors such as tannins, oxalates, phytates and saponins. This therefore, calls for some form of processing such as boiling. It is important to note that, the nature and hardness of seed coat of a legume and duration of boiling may influence the process of eliminating or reducing the level of anti-nutritional factors. Therefore, it is necessary to evaluate the effect of boiling period on the chemical properties of each legume. At the moment, base-line information on the effect of varying boiling periods on the chemical composition of *Senna occidentalis* seeds seems to be very scanty hence the need to conduct more studies and bridge this information gap.

It is in view of the above that this study was conducted to investigate the effects of varying boiling periods on the chemical composition of *Senna occidentalis* seeds.

### Materials and Methods

The seed samples were collected from bushes in Mubi area of Adamawa State Nigeria. The seed samples were divided into five (5) representative samples of 200 g each. The first sample was left unboiled (raw) while the second (T2) third (T3) fourth (T4) and fifth (T5) samples were subjected to boiling periods of 30, 40, 50 and 60 minutes, respectively. The boiled seeds were drained, properly sun-dried and ground into meal ready for the chemical analysis. The proximate composition of the representative seed meal samples and levels of the anti-nutritional factors were determined in triplicates in a completely randomized designed using the standard laboratory procedure of Official Association of Analytical Chemists [AOAC] (2004).The amino acid profile was analysed using High-Performance Liquid Chromatography (HPLC) Buck Scientific BLC 10/11 model equipment.

Data obtained were subjected analysis of variance (ANOVA) and least significant difference (LSD) was used to separate treatment means for the proximate composition, amino acid profile and levels of anti-nutritional factors.

**Results and Discussion**

The proximate composition of *Senna occidentalis* subjected to varying boiling periods is presented in table 1. The proximate composition was significantly ($p<0.05$) influenced by the boiling periods except for the dry matter. The crude protein, ether extract, crude fibre and ash were observed to significantly ($p<0.05$) decrease as the boiling period progress with boiling periods at 50 and 60 minutes indicating the highest level of reduction for the proximate components. The decrease in crude protein observed in this study was attributed to the leaching out of soluble nitrogenous compound as reported by Nsa *et al*. (2011) and Shaabu *et al*. (2015). The decrease in the ether extract was attributed to the impact of heat on the oil content of the seed and sieving out of the oil in boiling water. This is in line with the findings of Udedibie *et al*. (1996) and Augustine *et al*. (2017) who observed same for jack bean and *Senna obtusifolia* seeds. The decrease in the fibre content was in agreement with the findings of Iorgyer *et al*. (2009). The decrease may be attributed to the impact of heat on the structural fibre components of the seed coat of *Senna occidentalis* seeds. The reduction in the ash content observed as the boiling period progresses might be due to the leaching out of minerals in the boiling water which is in line with the findings of Nsa *et al*. (2011) who observed same for castor oil seeds. The increase in the nitrogen free extract was attributed to the impact of heat in the boiling water which might have opened up the locked-up crude carbohydrates for easy bio-accessibility. The increase agrees with the findings of Shaahu *et al*. (2015) who made a similar observation for lablab seed.

Table 1: Proximate composition of *Senna occidentalis* subjected to varying boiling periods

| | Boiling periods (minutes) | | | | | |
|---|---|---|---|---|---|---|
| Nutrients (%) | T1(0) | T2(30) | T3(40) | T4(50) | T5(60) | SEM |
| Dry matter | 92.51 | 91.80 | 92.19 | 92.15 | 92.25 | 3.01 |
| Crude protein | 21.70$^{a}$ | 20.30$^{a}$ | 20.19$^{a}$ | 19.07$^{ab}$ | 18.13$^{c}$ | 1.12 |
| Crude fibre | 13.80$^{a}$ | 13.75$^{a}$ | 12.30$^{b}$ | 11.08$^{c}$ | 10.14$^{e}$ | 2.86 |
| Ether extract | 2.50$^{a}$ | 2.30$^{ab}$ | 2.00$^{b}$ | 1.98$^{c}$ | 1.96$^{c}$ | 0.04 |
| Ash | 5.42$^{a}$ | 4.11$^{b}$ | 3.87$^{b}$ | 3.61$^{c}$ | 3.01$^{c}$ | 0.97 |
| NFE | 46.91$^{c}$ | 42.40$^{b}$ | 40.00$^{b}$ | 42.11$^{a}$ | 43.14$^{a}$ | 4.31 |
| Energy (kcal/kg) | 2290.15 | 2300.30 | 2329.03 | 2397.44 | 2361.04 | - |

a, b, c, = Means in the same row with different superscripts are significantly different at 5% level of probability; metabolizable energy (ME) calculated according to the formula of Pauzenga, (1985), ME = 37 x %CP + 81 x %EE + 35.5 x NFE, NFE = nitrogen free extract.

The amino acid profile of *Senna occidentalis* seeds (Table 2) subjected to varying boiling periods showed similar reduction trend as that of the proximate composition. This may similarly be due sieving out of the soluble nitrogenous compound in the boiling water which agrees with the findings of Udensi *et al*. (2010). The ultimate goal of processing is to eliminate or reduce anti-nutritional factors to safer-threshold. The varying boiling periods significantly ($p<0.05$) decreased the level of anti-nutritional factors (Figure I). However, boiling at 60 minutes indicated the highest level of reduction for all the anti-nutrients. A similar observation was made by Udensi *et al*. (2010) and Abeke *et al*. (2008).

Table 2: Amino Acid Profile of *Senna occidentalis* Seeds Subjected to Varying Boiling Periods

| | Varying boiling periods (minutes) | | | | | |
|---|---|---|---|---|---|---|
| Amino acid (g/100g) | T1(0) | T2(30) | T3(40) | T5(50) | T6(50) | SEM |
| Lysine | 4.2$^{a}$ | 3.80$^{b}$ | 3.21$^{b}$ | 3.18$^{b}$ | 2.41$^{c}$ | 0.08 |
| Methionine | 1.35$^{a}$ | 1.20$^{a}$ | 1.21$^{a}$ | 1.01$^{b}$ | 0.98$^{c}$ | 0.03 |
| Threonine | 2.85$^{a}$ | 2.20$^{ab}$ | 2.10$^{b}$ | 2.30$^{b}$ | 1.71$^{c}$ | 0.01 |
| Isoleucine | 3.24$^{a}$ | 2.82$^{b}$ | 2.80$^{b}$ | 2.79$^{b}$ | 1.85$^{c}$ | 0.09 |
| Leucine | 3.64$^{a}$ | 3.40$^{a}$ | 3.20$^{a}$ | 2.00$^{b}$ | 1.68$^{c}$ | 0.07 |
| Phenylalanine | 4.31$^{a}$ | 3.82$^{b}$ | 3.67$^{b}$ | 3.25$^{b}$ | 2.08$^{c}$ | 0.11 |
| Valine | 5.34$^{a}$ | 4.00$^{b}$ | 3.90$^{b}$ | 3.85$^{b}$ | 2.75$^{c}$ | 0.21 |
| Histidine | 2.85$^{a}$ | 2.20$^{b}$ | 2.17$^{b}$ | 2.00$^{b}$ | 1.95$^{c}$ | 0.04 |
| Arginine | 2.80$^{a}$ | 2.30$^{a}$ | 2.15$^{a}$ | 1.79$^{b}$ | 1.09$^{c}$ | 0.01 |
| Serine | 2.79$^{a}$ | 2.85$^{a}$ | 2.81$^{a}$ | 1.97$^{b}$ | 2.71$^{b}$ | 0.03 |
| Tyrosine | 3.20$^{a}$ | 3.00$^{a}$ | 2.97$^{b}$ | 2.87$^{b}$ | 2.61$^{c}$ | 0.06 |
| Alanine | 3.70$^{a}$ | 3.50$^{a}$ | 2.97$^{b}$ | 2.71$^{b}$ | 1.66$^{c}$ | 0.09 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Aspartic acid | 3.05[a] | 2.95[a] | 2.40[b] | 1.51[c] | 1.35[c] | 0.07 |
| Glutamic acid | 9.95[a] | 9.87[a] | 9.50[a] | 9.01[b] | 7.11[c] | 0.02 |
| Proline | 1.75[a] | 1.62[a] | 1.50[b] | 1.48[b] | 0.66[c] | 0.001 |

a, b, c, = Means in the same row with different superscripts are significantly different at 5% level of probability

The mechanism by which heat treatment eliminates or reduces anti-nutritional factors was earlier explained by Abeke *et al*. (2008) that heat denatures protein and since anti-nutritional factors are protein substances, they tend to be denatured by heat treatment. However, the rate of denaturation of protein differs from protein to protein and that anti-nutritional factors are denatured more quickly from legume beans than the real protein content of the bean or seed.

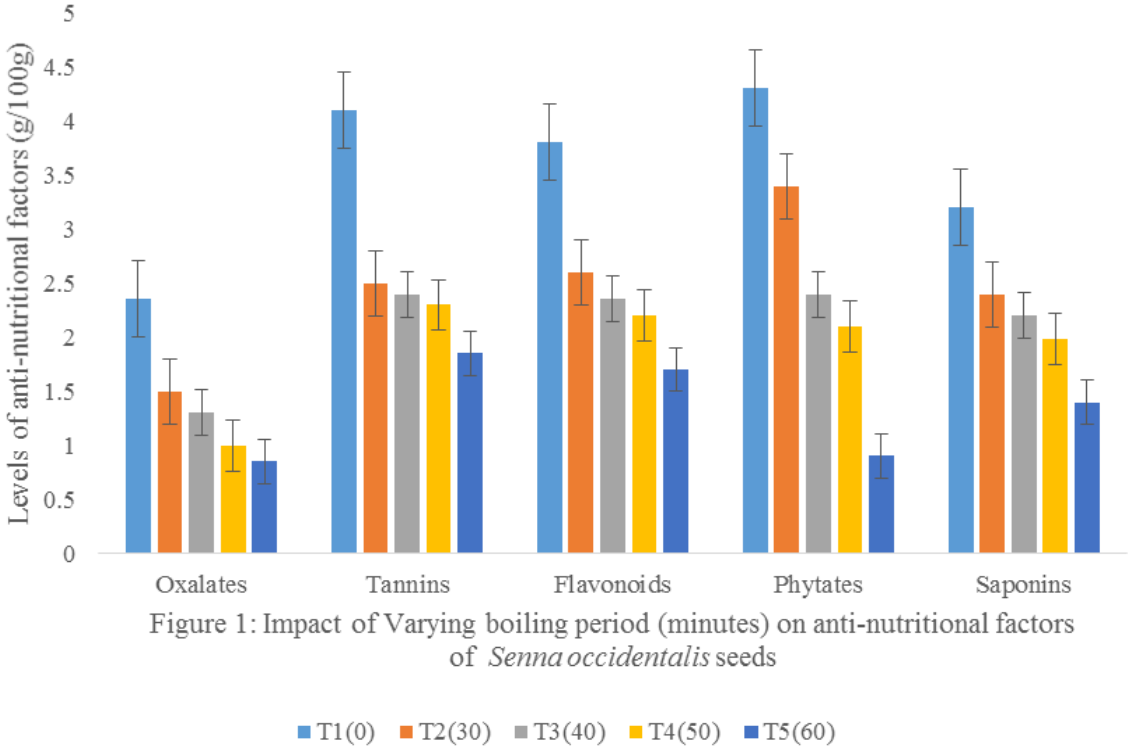



Figure 1: Impact of Varying boiling period (minutes) on anti-nutritional factors of *Senna occidentalis* seeds

**Conclusion**

The outcome of this study revealed that the proximate composition, amino acid profile and levels of anti-nutritional factors of *Senna occidentalis* decreased with increase in boiling duration except for the ether extract. However, boiling at 50 and 60 minutes showed the highest level of reduction for these components. It was concluded that *Senna occidentalis* seeds can be boiled up to 60 minutes with less depreciation in nutritional values.

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