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The Proximate Composition of S. Nigrum Plant-Leaves Consumed in the Eastern Cape Province of South Africa

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Abstract. The aim of this study was to determine the proximate composition of *S. nigrum* plant-leaves locally consumed in the Eastern Cape Province of South Africa. Plant-leaves of *S. nigrum* were analysed for proximate composition according to AOAC standard procedures. The moisture content was determined gravimetrically by oven-drying of samples at 105^0C. Ash content was determined gravimetrically by igniting the sample in a muffle furnace at 550^0C for 5 hours. Fibre was determined gravimetrically after gelatinisation of the sample with heat stable α-amylase, which was followed by the enzymatic digestion with protease and amyloglucosidase to remove protein and starch, respectively. Fat and fatty acids were extracted by hydrolytic method which was followed by methylation of fatty acids and their subsequent quantification by capillary gas chromatography with flame ionization detection. Proteins were analysed by Dumas method of combustion. Carbohydrates and energy were calculated by deference. The mean values for carbohydrates, protein, fibre, fat, ash and moisture were 20.0, 32.3, 26.9, 1.8, 12.4 and 6.6 (g/100g), respectively. Amounts of soluble sugars such as sucrose, maltose, glucose, and fructose were 0.4, 4.1, 5.1 and <0.1 g/100g, respectively. These results indicate that *S. nigrum* could serve as potential source of important dietary nutrients for the alleviation of problems associated with malnutrition in South Africa.

Keywords: African leafy vegetable; Malnutrition, *S. nigrum*; Eastern Cape; South Africa.

1. Introduction

The leaves of *S. nigrum* are consumed as vegetable in the rural areas of the Eastern Cape Province and other parts of South Africa [1]. *S. nigrum* is widespread throughout Africa and is a weed that grows wild in fields as well as other locations, although it is occasionally cultivated It is referred to as black nightshade in English and *Umsobo* in isiXhosa and belongs to the family Solanaceae [2] and [3]. It is generally consumed during times when other foods are scarce or as medicinal treatment. Human consumption of the leaves usually reflects a lack of availability of other preferred foods [4]. Studies carried out in different parts of the world indicate that *S. nigrum* is a rich source of nutrients, antioxidants and important dietary elements [1] and [5]. However, many indigenous leafy vegetables including *S. nigrum* are neglected and despised in the urban areas of South Africa, despite their nutritional richness and potential to contribute to healthier diets in the country. *S. nigrum* is known to be resistant to pests, diseases and thrives well in minimally nutritive soils [6]. Scientific studies to determine the role of *S. nigrum* and other indigenous leafy vegetables in the formulation of healthy diets in South Africa are imperative considering the high level of malnutrition in the country [7]. The underutilisation and marginalisation of these vegetables particularly in the urban areas may be attributed to the lack of scientific data on their nutritive properties, hence the need for this study.

2. Materials and Methods

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2.1. Collection and Preparation of Plant Material

The young shoots and leaves of *S. nigrum* were harvested around Walter Sisulu University main campus in Mthatha, in October 2012. The plant samples were identified by Dr. Kathleen Immelman of the department of botany and vouchers deposited in the Kei herbarium (CN02). The plant material was washed, dried at 50 ˚C for 24 hours, powdered (ATO Mix, Cambridge) and stored in airtight containers at 5 ˚C for further analysis.

2.2. Proximate Analysis

Proximate determination which involved protein, fats, carbohydrates, dietary fibre, moisture, ash and energy was analysed in accordance with the Association of Official Analytical Chemists (AOAC) method as previously described [8] and [9]. Briefly, 100g of the vegetable sample was subjected to 105±3˚C in the oven for 5 hours and the moisture content determined gravimetrically. The ash content was gravimetrically determined by incinerating the sample in a muffle furnace at 550 ± 15 ℃ for 24 hours.

The fats were extracted into ether and dried and the fatty acids methylated to fatty acid methyl esters (FAMEs) using sulphuric acid in methanol. FAMEs were then quantitatively measured by capillary gas chromatography with flame ionization detection. Total dietary fibre (TDF) was determined gravimetrically after gelatinisation of the sample with heat stable α-amylase, which was followed by the enzymatic digestion with protease and amyloglucosidase to remove protein and starch, respectively. Crude protein was determined using nitrogen analyser (LECO TruSpec, Gauteng) based on the Dumas or protein combustion method [10]. Elemental nitrogen released from protein combustion at 1200 ˚C was calculated by using the nitrogen to protein conversion factor of 6.25 times N, where N = total nitrogen [10].

Available carbohydrates were estimated by difference, by subtracting the total sum of percent crude protein, total fat, dietary fibre, moisture and ash from 100% dry weight of the leaves. The caloric value in (KJ) was estimated by multiplying the percentages of Protein, Total fat and Carbohydrate by the factors 16.7, 37.7 and 16.7 respectively [11]. Each determination was repeated twice and mean and standard deviations recorded.

3. Results

3.1. Proximate Composition

The results of the proximate analysis in g/100g as shown in Table I revealed that carbohydrate, dietary fibre, moisture, ash, protein, and energy (kJ/100g) mean values were 20.0, 26.9, 6.6, 12.4, 32.3, and 730, respectively. Sucrose, glucose, and maltose were 0.4, 5.1, and 4.1 (g/100g), respectively. Fructose was less than 0.1 g/100g and no lactose was detected. Total fat was 1.8 g/100g of which 67% was polyunsaturated fatty acids (1.2 g/100g), 28% was the monounsaturated fatty acids (0.5 g/100g) and 6% was saturated fatty acids (0.1 g/100g). Trans-fatty acids were not detected.

Table I: Proximate composition of S.nigrum (g/100 g) dry weight

Nutrient	***S. nigrum***
Carbohydrates	20.0 ±0.0
Dietary Fibre	26.9 ±0.0
Energy	730 ±0.0[h]
Moisture	6.6 ±0.0
Ash	12.4 ±0.5
Protein	32.3 ±1.6
Total sugar	9.6 ±0.6
Sucrose	0.4 ±0.0
Fructose	< 0.1
Glucose	5.1 ±0.0
Lactose	ND
Maltose	4.1 ±0.6
Total Fat	1.8 ±0.0
Saturated FA	0.1 ±0.0
MUFAs	0.5 ±0.0
PUFAs	1.2 ±0.1
Transfat	ND

Data are mean ±SD of triplicate determinations for each nutrient. h, KJ/100g .

4. Discussion

The recommended daily allowance (RDA) values of dietary fibre for children, adults, pregnant and lactating mothers are 19-25, 21-38, 28 and 29g, respectively [3], therefore *S. nigrum* is a good sources of fibre. According to Antia et al. [12] non-starchy vegetables are the richest sources of dietary fibre. Adequate intake of dietary fibre can lower the serum cholesterol level, risk of coronary heart disease, hypertension, constipation, diabetes, colon and breast cancer [13] and [14].

Emebu and Anyika [15] stated that most leafy vegetables are generally not necessarily good sources of carbohydrate even though carbohydrates are pivotal nutrients required for adequate diet. The RDA values of carbohydrates for children, adults, pregnant and lactating mothers are 130g, 130g, 175g and 210g, respectively. The vegetables species in this study are poor sources of carbohydrates. This makes *S. nigrum* studied herein a poor source of carbohydrates.

Protein content for *S. nigrum* is in accordance with the report of Taiga et al. [16] that protein level of green leafy vegetable ranged from 20.48 to 41.66% DW. It is adequate for the RDA protein values for adults, children, pregnant and lactating mothers, 34-56, 13-19, 17 and 71g, respectively [3]. Plant food that provides more than 12% of its caloric value from protein is considered good source of protein [14].

Moisture also makes the leaves perishable and susceptible to spoilage by microorganisms during storage [17]. Low moisture content in *S. nigrum* would hinder the growth of microorganisms and storage life would be high [18]. Ash content is an index of mineral contents in biota that is it is the reflection of the mineral contents preserved in the food materials [12]. High ash content in the leaves therefore, suggests a high deposit of mineral elements. *S. nigrum* showed minimal fat content.

A diet providing 1-2% of its calories of energy as fat is said to be sufficient to human beings as excess fat consumption is implicated in certain cardiovascular diseases such as atherosclerosis, cancer and ageing [12]. Dietary fats function in the increase of palatability of food by absorbing and retaining flavours [12].

The results of this study indicate that *S. nigrum* may constitute alternative additional sources of important dietary components.

5. Conclusion

S. nigrum leaves may play a crucial role in alleviating problems associated with nutritional deficiencies in South Africa. They have a major advantage of adaptability to harsh climatic conditions and therefore could fill a valuable niche in the production of food in rural areas where climate is not conducive for the propagation of exotic species which usually require steady supply of water for successful cultivation.

Important dietary components of carbohydrates, protein, fibre, are herein detected from the leaves of *S. nigrum*, thus providing preliminary scientific validation for their use as vegetable in the rural areas of South Africa. Further studies to determine the safety parameters of *S.nigrum* as a vegetable and the effects of different processing methods on the bioavailability of its nutrients are imperative. These aspects are under consideration in our research group.

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7. References

[1] A.J. Afolayan, F.O. Jimoh. Nutritional quality of some wild leafy vegetables in South Africa. *Inter. J. Food Sci. Nutr*. 2009, 60(5):424-431.

[2] M. Husselman, N. Sizane. Imifino: A guide to the use of wild leafy vegetables in the Eastern Cape. Gahamstown:

ISER 2006 1-37.

[3] I.E. Akubugwo, A.N. Obasi, S.C. Ginika. Nutritional potential of the leaves and seeds of black nightshade-*Solanum nigrum* L. var virginicum from Afikpo-Nigeria. *Pak. J. Nutr*. 2007, 6, 323-326.

[4] R.S. Glew, B. Amoako-Atta, G. Ankar-Brewoo, J. Presley, L. T. Chang, M. Millson, B. R. Smith, R.S. Glew. Non-cultivated Plant Foods in West Africa: Nutritional Analysis of the leaves of Three Indigenous Leafy Vegetables in Ghana. *Food* 3 (1): 39-42.

[5] J. Hussain, A.L. Khan, N.U. Rehman, M. Hamayun, T. Shah, M. Nisar, T. Bano, Z.K. Shinwari, I.J. Lee. Proximate and nutrient analysis of selected vegetable species: A case study of Karak region, Pakistan. *Afr. J. Biotechnol*. 2009, 8(12):2725-2729.

[6] K. Gensiki, K Nowak. Comparative analysis of the biological value of protein of *Chenopodium quinoa* Wild and *Chenopodium album* L. Part II. Amino acid composition of the green matter protein. *Acta Sci. Polonorum Agric*. 2011, *10*(3):57-65.

[7] T. Puoane, K. Steyn, D. Bradshaw, R. Laubscher, J. Fourie, V. Lambert, N. Mbananga. Obesity in South Africa: The South African demographic and health survey. *Obesity Res*. 2002, 10:1038-1048.

[8] AOAC. Official Methods of Analysis of the Association of Official Analytical Chemists (15th edition), Washington DC, 1990, 992-995.

[9] W.K.J. Kwenin, M. Wolli, B.M. Dzomeku. Assessing the nutritional value of some African indigenous green leafy vegetables in Ghana. *J. Ani. Plant Sci*. 2011, 10:1300-1305.

[10] R.L. Miller-Cebert, N.A. Sistani, E. Cebert. Comparative protein and folate content among canola cultivars and other cruciferous leafy vegetables. *J. Food, Agric. Environ*. 2009, 7(2):46-49.

[11] Aberoumand. Screening of less known two food plants for comparison of nutrient contents: Iranian and Indian vegetables. *Func. Foods Health Dis*. 2011, 10:416-423.

[12] B. S. Antia, E.J. Akpan, P. A. Okon and I. U. Umoren. Nutritive and Antinutritive Evaluation of Sweet Potatoes (Ipomoea batatas) Leaves. *Pakistan Journal of Nutrition.* 2006, 5 (2): 166-168.

[13] R. Hanif, Z. Iqbal, M. Iqbal, S. Hanif, M. Rasheed. Use of Vegetables as Nutritional Food: Role in Human Health. *Journal of Agricultural and Biological Science*. 2006, 1 (1): 18-22.

[14] F. O. Jimoh, A.A. Adelapo, A.A. Aliero, S. Koduru, A. J. Afolayan. Evaluation of the Polyphenolic, Nutritive and Biological Activities of the Acetone, Methanol and Water Extracts of *Amaranthus asper. The Open Complimentary Medicine Journal*, 2010, 2, 7-14.

[15] P. K. Emebu, J. U. Anyika. Proximate and Mineral Composition of Kale (*Brassica oleracea*) Grown in Delta State, Nigeria. *Pakistan Journal of Nutrition*, 2011, 10 (2): 190-194.

[16] A. Taiga, M.N. Suleiman, D. O. Aina, W.F. Sule, G. O. Alege. Proximate analysis of some dry season vegetables in Anyigba, Kogi State, Nigeria. *African Journal of Biotechnology*, 2008, 7 (10): 1588-1590.

[17] C. V. Nnamani, H.O. Oselebe, A. Agbatutu. Assessment of nutritional values of three underutilized indigenous leafy vegetables of Ebonyi State, Nigeria. *African Journal of* Biotechnolog y, 2009, 8 (9): 2321-2324.

[18] O.M. Iniaghe, S.O. Malomo, J.O. Adebayo. Proximate Composition and Phytochemical Constituents of Leaves of Some Acalypha Species. *Pakistan Journal of Nutrition*, 2009, 8(3): 256-258.