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ORIGINAL ARTICLE

Proximate and Mineral Composition of Vegetable Salad without Dressing

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Abstract

Salad is a dish of raw vegetables with or without dressing. The study aimed to determine the vegetable salad's proximate, minerals, and daily percentage value without dressing to the dietary regimen. Vegetable salads without dressing were purchased and analysed to evaluate proximate and minerals analysis based on the Association of Official Analytical Chemists (AOAC). The results revealed that vegetable salad without dressing contained 83.20 ± 0.10 moisture content, 16.80 ± 0.01 dry matter, 1.73 ± 0.14, 3.01 ± 0.40, 0.87 ± 0.01, 0.73 ± 0.00, and 10.50 ± 0.12g/100g as in crude lipid, crude protein, crude fibre, ash content, and carbohydrate respectively. Potassium (K), sodium (Na), calcium (Ca), phosphorus (P), magnesium (Mg), manganese (Mn), iron (Fe), zinc (Zn), and copper (Cu) were 464 ± 3.56, 236 ± 2.45, 101 ± 1.63, 124 ± 1.63, 58 ± 0.81, 0.49 ± 0.06, 0.88 ± 0.01, 0.84 ± 0.02, and 0.21 ± 0.01 mg/100g respectively. The percent calorific values from carbohydrates, fat, and protein could help to reduce the risk of chronic disease. The salad is a good source of magnesium, manganese, phosphorus, and copper. The study showed that the salad is good for a healthy body, hypertensive and obese patients.

Keywords: Calorific value, Dietary contribution, Proximate and minerals composition, Vegetable salad

Introduction

Salad is a dish of raw or cooked vegetables served with or without dressing (Iheanacho and Udebuani, 2009). It is cooled and refreshing any time of the day. It supplies some of the water, minerals, vitamins, antioxidants and phytochemicals required by the body. Salad without dressing is meals of different vegetables. Therefore, it is consumed as a side dish.

Vegetables are leaves, stems, roots, flowers, seeds, fruits, bulbs, tubers, and fungi (Iheanacho and Udebuani, 2009; Pem and Jeewon, 2015). They are cheap and good carbohydrates, fibre, proteins, vitamins, minerals, and essential amino acids (Slavin and Lloyd, 2012). Vegetables provide health benefits such as a reduction of chronic diseases like coronary heart disease (Tang et al., 2017; Zheng et al., 2017), stroke (Hu et al., 2014; HealthDay News, 2020), blood pressure (Nyundu et al., 2018; Harvard Heart Letter., 2019), osteoporosis (Qiu et al., 2017; Brondani et al., 2019), cancers (Wang et al., 2014; Wang et al., 2015), chronic obstructive

pulmonary diseases (Kaluza et al., 2017; Medical News Today Newsletter, 2017; Kaluza et al., 2018), diabetes (Imai et al., 2013; Li et al., 2014), respiratory problems (Hosseini et al., 2017), and mental health problems (Nguyen et al., 2017; Ju and Park, 2019).

Minerals and trace elements account for almost 4% of total body mass. They play a unique role in the bone structures and regulate body functions. Wherefore, the combination of water help in the water body balance. Water makes up 60% of the body weight. The study aimed to evaluate vegetable salad's proximate and mineral compositions without dressing and the contributions to the dietary regimen.

Materials and Methods

Source of Material

Two plates of vegetable salad without dressing were purchased from a commercial food outlet. The salad was dried in an air oven at 60 °C for 24 h and ground into fine form in a blender. Components of the salad are cucumbers, tomatoes, onions, lettuce, carrots, cabbages, sweet corns, potatoes, boiled egg (white), Titus fish, twist and rivocca macaroni.

Proximate Analysis

The proximate composition of the vegetable salad without dressing was determined using the AOAC methods for moisture, ash, crude protein, crude fat, crude fibre content, and carbohydrate was calculated by adding other constituents of the proximate subtracted from 100 (AOAC, 2005). All were carried out in triplicate.

Determination of Moisture Content

Two grams of the ground vegetable salad without dressing were weighed into the crucible (W_1). The sample was dried at 105 ºC in an air oven for five h and cooled in a desiccator to a constant weight (W_2). Moisture content was calculated based on equation 1.

$$\%\ Moisture\ = \frac{W_1 - W_2}{W_1 - W_3} \times 100 \quad (1)$$

W*here* W_3 is the weight of the crucible.

Determination of Ash Content

Five grams of the ground sample were spread evenly on an ignited crucible (W_1). The sample was transferred to a muffle furnace, ignited at 500 ºC until it turned grey and cooled in a desiccator to a constant weight (W_2). The percentage of the ash was calculated as in equation 2.

$$\%\ Ash\ (CTA) = \frac{W_2 - W_3}{W_1 - W_3} \times 100 \quad (2)$$

W*here* W_3 is the weight of the crucible.

Determination of Crude Protein

Two grams of the ground sample were placed in 500 mL Kjeldahl digestion flask. A-One gram of Kjeldahl catalyst and 15 mL sulfuric acid were added and heated gently until a clear solution was obtained at four h. The solution was allowed to cool and cautiously diluted with 10 mL distilled water, and 10 mL of 40% (w/v) NaOH was added. Immediately, the digestion flask was connected to a receiver flask of 5 mL boric acid and methyl red bromocresol green mixed indicator, stirred and digested until all NH_3 was distilled out. The condenser tip was rinsed with distilled water and

titrated with the excess acid of 0.01 M HCl. Crude protein was calculated based on the following equation 3.

$$\%\ Crude\ protein\ (CP) = \frac{Titre \times 14.01 \times Molarity\ of\ the\ acid\ \times 6.25 \times 100}{Weight\ of\ the\ sample \times 1000} \quad (3)$$

W*here* 6.25 was a general conversion factor suitable for products in which the portion of a specific protein was not well defined. 14.01/1000 was a constant and the titer was the volume of titrant.

Determination of Crude Fat

Five grams of the ground sample in a filter paper, wrapped and placed in an extraction thimble. In a Soxhlet extraction flask, the thimble with filter paper was put and added 200 mL ethyl ether. This sample was extracted for 6 to 8 h at a 3 - 6 drops per second condensation rate. After the extraction, the fat extract was transferred into a dried and pre-weighed crucible and rinsed severally with ethyl ether. The crucible with the sample was evaporated to remove the traces of ethyl ether, dried at 105 ºC for 30 min, cooled to a constant weight in a desiccator.

$$\%\ Crude\ fat\ (CFE) = \frac{(\text{Weight of dish \& sample after drying } -\ \text{Weight of dish})}{\text{weight of sample before drying}} \times 100 \quad (4)$$

Determination of Crude Fiber

Two grams of ground sample was weighed in a dried crucible (W_1) and placed in a 1 L conical flask. Hot sulfuric acid solution (200 mL, 1.25% (v/v)) was added to the flask, digested for 30 min with constant swirling, and filtered. The residue was rinsed three times with hot water and transferred to a cleaned and dried conical flask. The digestion procedure was repeated with washed residue using NaOH (200 mL, 1.25%, (v/v)), sulfuric acid and a few drops of *n*-octanol. The obtained residue was dried at 105 ºC and cooled to a constant weight (W_2).

$$\%\ Crude\ Fiber\ (CF) = \frac{(W_1 + W_2) -\ W_1}{\text{weight of sample before drying}} \times 100 \quad (5)$$

Determination of Carbohydrate

Total carbohydrate was calculated by the addition of other constituents of the proximate and then subtracted from 100.

Total carbohydrate (TC)= 100 − [*% CP + % CFE + % CF + % CTA*] (6)

Estimation of the calorific value

The calorific energy was calculated using the constant described by the United Kingdom Department of Health (UKDH) (UKDH, 2013) as shown in equation 7.

Calorific energy (CE) = (*CP* × 4.00) + (*CFE*× 9.00) + (*TC* × 3.75) (7)

Determination of Minerals

The ash content is the total amount of minerals available within a food, whereas the mineral content is the amount of specific inorganic components. Therefore, the evaluation revealed the concentration, quality, nutrition, and processing information of foods. The ash obtained from the proximate analysis was digested with HCl (5 mL, 2 M), cooled, and filtered. The filtrate was made up to 100 mL in a volumetric flask with distilled water.

The solution was transferred to a plastic bottle labelled accurately, stored and used for minerals determination. This was performed in triplicate. The Na, K, and Ca were analysed using flame spectrophotometer (Jenway Digital Flame Photometer PFP7/C model); Mg, Mn, Cu, Fe, and Zn by atomic absorption spectrometry and P by Vanadate-Molybdate spectrophotometer all according to the standard methods (AOAC, 2005).

DV percent daily value (DV) of minerals

The percent daily value (% DV) of minerals is shown in equation 8.

$$\%\ DV\ of\ minerals = \frac{\text{Amount of mineral in 100 g salad}}{\text{Recommended daily value}} \times 100 \quad (8)$$

Results and Discussion

The proximate composition of the vegetable salad without dressing is presented as means and standard deviations (Table 1) and % calorific values (Table 2). Moisture content is an essential component of the proximate analysis that gives an index of water activity. The moisture content (83.18 ± 0.10) was within 71.10 – 96.5% reported for fresh fruits and vegetables (UKDH, 2013). The high moisture indicates that routine intake of the salad can increase the body's water for easy digestion, absorption, and transportation. Crude lipid, 1.73 ± 0.14 was higher than mixed vegetable salad (0.8g) (Sparkrecipe, 2019). The vegetable salad without dressing contributed 15.57 Kcal/100g and 23.27% calories (Table 2) which was within 20-35% recommended health values as needed to reduce the risk of chronic disease (NHMRC, 2013). The crude protein was 3.01 ± 0.40, which contributed 17.99% calorific value. According to Ali (Ali, 2009), plant foods that provide >12.0% of its calorific value from protein are good protein sources. Also, vegetable salad without dressing meets 15-25% required to reduce risk of chronic disease (Self Nutrition Data, 2019).

The carbohydrate content from vegetable salad without dressing was in line with 10.0 g of vegetable salad reported in Self Nutrition Data (Self Nutrition Data, 2019). The calorific value of vegetable salad without dressing contributed 58.74%, higher than 31% of vegetable salad (Self Nutrition Data, 2019). This value was within 45-65 % of recommended health values as needed to reduce the risk of chronic disease (NHMRC, 2013). Therefore, 47 - 64% was ideal in reducing the risk of overweight or obesity (Merchant et al., 2009). In addition, the calorific values from carbohydrates, fat, and protein could help to reduce the risk of chronic diseases (NHMRC, 2013). Therefore, the study of vegetable salad without dressing will be useful in controlling overweight and obesity.

Table 1: Proximate composition of vegetable salad without dressing (g/100g)

Nutrients	g/100g
Moisture	83.18 ± 0.10
Dry matter	16.82 ± 0.01
Crude lipid	1.73 ± 0.14
Crude protein	3.01 ± 0.40
Crude fiber	0.87 ± 0.01
Ash content	0.73 ± 0.00
Carbohydrate	10.48 ± 0.12

Crude fibre contributes to the bulkiness needed for easy digestion and absorption processes in the large intestine. Thereby, prevent constipation, diarrhoea, bowel function, colon cancer, even polyps, haemorrhoid, rectal fissures, and diverticulosis. The crude fibre content of

0.87g/100g of vegetable salad without dressing was lower than 2.7 g mixed vegetable salad (Sparkrecipe, 2019).

Table 2: Calories contribution of vegetable salad without dressing

Nutrients	Calories Kcal/100g	% Calorific value
Carbohydrate	39.30	58.74
Protein	12.04	17.99
Lipid/fat	15.57	23.27
Total	66.91	100.00

The ash is a measure of minerals present in food. It has an essential mineral needed in metabolic processes and its absence may impair metabolism. The ash measured was in line with 0.70 ± 0.12 of *Talinum triangular* (Akinnibosun and Adeola, 2015). The mineral contents are reported as means ± standard deviation (Table 3) and the % DV of the minerals (Table 4). The sodium (236 ± 2.45 mg/l00 g) of vegetable salad without dressing was higher than ~227 mg of vegetable salad (Self Nutrition Data, 2019). This was compared to the Tolerable Upper Intake Level (UL) (1,900-2,300 mg) of Na for 4-51 years (IM, 2006). Therefore, the studied salad contributed 10.26-12.42%, which was higher than ~9% of vegetable salad (Self Nutrition Data, 2019). Potassium plays a unique role in maintaining normal cell function (Elliott, 2017). In vegetable salad without dressing, K was found 464 ± 3.56 mg/l00 g, lower than ~563 mg vegetable salad (Self Nutrition Data, 2019). An Adequate Intake (AI) (3,800-4,700 mg) of K for 4-51 years (IM, 2006) was compared with the studied salad, 9.87-12.21% (Table 4). The ratio of Na to K should be lower than 1 in food to prevent or manage the risk of high blood pressure (Park *et al.,* 2016). Therefore, the studied salad had 0.51 to prevent or manage the risk of high blood pressure.

Table 3: Mineral composition of vegetable salad without dressing (mg/l00g)

Minerals	mg/l00 g
Potassium	464.00 ± 3.56
Sodium	236.00 ± 2.45
Calcium	101.00 ± 1.63
Phosphorus	124.00 ± 1.63
Magnesium	58.00 ± 0.81
Manganese	0.49 ± 0.06
Iron	0.88 ± 0.01
Zinc	0.84 ± 0.02
Copper	0.21 ± 0.01

Table 4: Percent Daily value of the minerals in 100g of vegetable salad without dressing.

Minerals	4-8 years	9-18 years	19-30 years	31-50 years	51+
Carbohydrate	8.06	8.06	8.06	8.06	8.06
Protein	15.84	5.79-8.85	5.38-6.54	5.38-6.54	5.38-6.54
Potassium	12.21	9.87-10.31	9.87	9.87	9.87
Sodium	12.42	10.26-10.72	10.26	10.26	10.26
Calcium	10.10	7.77	10.10	10.10	8.42-10.10
Phosphorus	24.80	9.92	17.71	17.71	17.71
Magnesium	44.62	14.15-24.17	14.50-18.71	13.81-18.13	13.81-18.13
Manganese	32.67	22.27-30.63	21.30-27.22	21.30-27.22	21.30-27.22
Iron	8.80	5.87-11.00	4.89-11.00	4.89-11.00	11.00
Zinc	16.80	7.64-10.50	7.64-10.50	7.64-10.50	7.64-10.50
Copper	47.72	23.60-30.00	23.33	23.33	23.33

The presence of calcium, phosphorus, and iron help in normal organs function. The Ca of vegetable salad without dressing was (101 ± 1.63 mg/l00 g) lower than ~121 mg vegetable salad (Self Nutrition Data, 2019). The RDA (Recommended Dietary Allowance) 1,000-1,300 mg of Ca for 4-51years (IM, 2010) was compared to a vegetable salad without dressing of 7.77-10.10%. This was lower than 12% vegetable salad (Self Nutrition Data, 2019). The P of vegetable salad without dressing was (124 ± 1.63 mg/l00 g) lower than ~173 mg vegetable salad (Self Nutrition Data, 2019). The RDA 500-1,250 mg of P for 4-51years (IM, 2006) was compared to the studied salad and contributed 9.92-24.80%. The Fe of vegetable salad without dressing was (0.88 ± 0.01 mg/l00 g). The RDA 8-18 mg of Fe for 19-51years (IM, 2006) and the studied salad contributed 4.89-11.00%, was lower than 19% vegetable salad (Self Nutrition Data, 2019).

Magnesium exhibits anti-osteoporotic activities and co-factor in many enzymatic reactions. The RDA 80-240 mg of Mg for 4-51years (IM, 2006) was compared to the studied salad. This vegetable salad without dressing contributed 13.81-44.62% higher than ~15.0% vegetable salad (Self Nutrition Data, 2019). The studied vegetable salad without dressing indicates a good source of Mg, especially for children. Furthermore, mg is in connection with cardiovascular disease (Severino et al., 2019).

The zinc (0.84 ± 0.02 mg/l00 g) of vegetable salad without dressing was lower than ~1.10 mg vegetable salad (Self Nutrition Data, 2019). Zinc and copper are two essential trace minerals required in many biochemical reactions and health maintenance. Zinc is involved in the functioning of the immune system, growth, brain development, behavioural response, bone formation, and wound healing (Hojyo and Fukada, 2016). The RDA 8-11 mg of zinc for 31-51years (IM, 2006) was compared to the studied salad, which contributed 7.64-10.50%, but higher than ~7% vegetable salad (Self Nutrition Data, 2019). Therefore, the Cu of vegetable salad without dressing was lower than ~0.40 mg vegetable salad (Self Nutrition Data, 2019). The RDA of 0.90 mg of copper for 30-51years (IM, 2006) and the present salad contributed 23.3% indicated a good source of Cu. Manganese regulates blood sugar levels, the production of energy, wound healing. It also helps in metabolism, bone health and development, and cell reproduction. The Mn in the present studied salad correlated with 0.40 mg of vegetable salad (Self Nutrition Data, 2019). The AI 1.80-2.30 mg of Mn for 30-51years (IM, 2006) was compared to the studied salad, which contributed 21.30-27.22%. Therefore, it is a good source of Mn.

Magnesium, manganese, phosphorus, and copper contributed the highest percentage of minerals needed to meet the daily requirement for maintaining a healthy body for ages 4-8 years and adults above 19 years (Table 4).

Conclusion

The vegetable salad without dressing was evaluated for proximate, mineral, and % daily minerals value. The salad is a good source of magnesium, manganese, phosphorus, and copper for 4-8 years and adults above 19 years. Also, it is suitable for obese and hypertensive patients and to maintain a healthy body.

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