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# Proximate Composition and Bacteriological Quality of Some Vegetables Sold in Parts of Taraba State, North-Eastern Nigeria

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## Abstract

Market-sold fresh vegetables are subjected to a variety of contaminants or pollutants. The proliferation of microorganisms, like bacteria, in food is caused by growth-promoting environmental conditions. Determining the bacterial quality and proximate composition of some lettuce and cabbage sold in certain areas of Taraba State is the goal of this study. The samples were collected from Taraba North (Jalingo and Zing Markets) and Taraba South (Wukari and Donga Markets), and their nutritional makeup or proximate composition was determined using method adopted from Association of Official Analytical Chemists and bacterial count was carried out using pour plate method. The mean moisture content of the vegetables was higher in cabbage (95.41±0.04) and lettuce (96.82±0.52) from Donga. Lettuce and cabbage from Jalingo had ash content of 0.99±0.04 and 0.91±0.04 respectively. Cabbage (0.70±0.88) and lettuce (0.85±0.026) from Jalingo and Zing respectively were found to have a high protein composition. The cabbage samples from Wukari (0.60±0.04) and Jalingo (0.38±0.02) had higher mean lipid contents. Cabbage from Wukari had a higher mean fibre composition (3.95±0.10). The amount of carbohydrates in lettuce from Wukari was found to be higher (3.94±0.08). The total bacterial count mean values were higher in the cabbage sample collected from the Zing market (1.43×107±1.43×105) and higher in the fresh lettuce sample collected from Wukari market (1.52×107±4.9×105). Bacterial


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contamination can cause vegetables to deteriorate and lose important nutrients. Vegetables sold in markets should therefore be properly washed and prepared before eating.

**Keywords:** Nutrients, Bacterial Load, Contamination, Cabbage, Lettuce

## INTRODUCTION

Food moisture content has a significant impact on the growth and survival of various microorganism groups since it is one of the most significant intrinsic factors influencing the growth of microorganisms in food. Food scientists consider moisture to be a crucial quality factor in food preservation (Afolabi *et al*., 2017). One of the earliest methods of food preservation that has been used is controlling the moisture content of food (Amit *et al*., 2017).

Microorganisms require larger amounts of certain minerals found in ash, such as potassium, sodium, calcium, and magnesium. They also require smaller quantities of other elements found in ash, such as aluminium, iron, copper, manganese, magnesium, calcium, and zinc (Tayyeb *et al*., 2017). Of all macromolecules, proteins are the most varied in their range of functions and are among the most prevalent organic molecules in biological systems (Rye *et al*., 2017). Foods originating from animals contain more proteins than foods originating from plants (Syamaladevi *et al*., 2016). The way that different microorganisms metabolise food proteins varies widely (Barak and Muchova, 2013).

Foods originating from animals have comparatively more lipids than foods originating from plants, however lipid contents are higher in nuts, oil seeds, coconuts, and olives (Caeser *et al*., 2016; Adams *et al*., 2018). Despite the fact that only a tiny percentage of food-borne microbes attack lipids, microorganisms nevertheless use them as energy sources (Caeser *et al*., 2016). According to Tayebb *et al*. (2017), crude fibres are made up of plant cells that remain intact despite being broken down by human digestive enzymes. These components include hemicellulose, lignin, oligosaccharides, pectins, gums, and waxes.

Microorganisms that are typically present in food can metabolise glucose, but they can also use other carbohydrate sources in quite different ways. Microorganisms metabolise carbohydrates through a variety of metabolic pathways primarily to provide energy

(Youssef *et al.*, 2014). Food's bacterium quality is a concern because, in both developed and developing nations, poor hygiene can allow food to act as a medium for the spread of pathogens. Food-borne illnesses caused by pathogen contamination represent a significant health burden on people (Alzubaidy *et al.*, 2013). Because pathogens can pose varying degrees of pathogenicity, it is imperative to study the prevalence of pathogens in our communities (Osman *et al.*, 2014).

## MATERIALS AND METHODS

### Collection of samples

For this study, cabbage and lettuce were used as samples. In each of the chosen research areas, two hundred vegetables were gathered from the selected markets. The samples were transported to the Department of Microbiology, Federal University Wukari in a sampling box with ice packs for determination of microbial load and the Institute of Agricultural Research in Zaria conducted the proximate analysis.

### Determination of Proximate Composition

**Determination of moisture content:** The determination of moisture was carried out using the method of Der-Jiun, et al. (2012). A crucible that had been cleaned was dried to a consistent weight at 105°C in a hot air oven. It was then cooled in desiccators and weighed (W1). A sample of food weighing 2 g was placed into the crucible that had been previously labelled and weighed again (W2). At 105°C, the container was dried in a hot air oven until its weight remained constant (W3). The following formula was used to get the percentage moisture content:

$$\% \text{ moisture content} = \frac{W_3 - W_1 \times 100}{W_2 - W_1}$$

**Determination of ash content:** The method described by the AOAC (2010) was used to determine the amount of ash. After being dried and cooled in a desiccator, a porcelain crucible was weighed (W1). Two grams of the food was placed into the weighed crucible and was reweighed (W2).). For eight hours, the sample was heated to 500 degrees Celsius in the boiler to guarantee adequate ashing. The crucible that held the ash was taken out, allowed to cool in desiccators, and then weighed (W3). Using the following formula, the percentage of ash content was determined:

$$\% \text{ ash content} = \frac{W_3 - W_1 \times 100}{W_2 - W_1}$$

**Determination of Nitrogen and crude protein**

**Protein Digestion:** The method of Babalola and Akinsoyinu (2011) was adapted. Briefly, 1.5 g of defatted sample in an ashless filter paper was dropped into 300 ml Kjeldahl flask. Twenty-five milliliters (25 ml) of $H_2SO_4$ and 3 g of digesting mix catalyst (which was weighed separately into an ashless filter paper) was dropped into Kjeldahl flask. The flask was then transferred to Kjeldahl digestion apparatus. The sample was digested until a clear green colour was obtained. The digest was cooled and diluted to 100 ml with distilled water.

**Distillation of the digest:** After measuring twenty millilitres of the diluted digest into a 500 millilitre Kjeldahl flask filled with anti-bumping chips, 40 millilitres of 40% NaOH were gradually added by the flask's side. To capture the released ammonia, a 250 ml conical flask was filled with a solution of 50 ml of 2% boric acid and 4 drops of mixed indicator. The tubes were then inserted into the Kjeldahl and conical flasks, and the two flasks were then set inside the Kjeldahl distillation apparatus. After that, heat was applied to the flask to extract the ammonia. The distillate was collected into boric acid solution. From the point when the boric acid turned green, 10 minutes was allowed for complete distillation of the ammonia present in the digest. The distillate was titrated with 0.1M HCl.

Calculation:

$$\% \text{ N} = \frac{14 \times M14 \times Vt \times Tv \times 100}{\text{Weight of Sample (mg)} \times V_s}$$

$$\% \text{ crude protein} = \% \text{ Nitrogen } (N_2) \times 6.25$$

Where M = Actual molarity of acid, Tv = titre volume of acid used, Vt = Total volume diluted digest, Vs = Aliquot volume distilled.

**Determination of crude lipid content:** A 500 ml dry round-bottom flask with a few anti-bumping granules was weighed (W1), and 300 ml of extraction-grade petroleum ether (40–60°C) was added to the flask equipped with a soxhlet extraction unit (AOAC, 2010). The soxhlet extraction unit was fixed with the extractor thimble containing 20 g of the sample. The extraction process took six hours to complete. The oil was dried in an oven set to 70°C

for one hour after the solvent was recovered (AOAC, 2010). After cooling in the desiccators, the round-bottom flask holding the oil was weighed (W2). Thus:

Percentage crude lipid content = % ash content = $\frac{W_2 - W_2 \times 100}{\text{Weight of sample}}$

**Determination of carbohydrate (by difference):** The total carbohydrate content was determined by difference. The sum of the percentage moisture, ash, crude lipid, crude protein and crude fiber was subtracted from 100 (Der-Jiun *et al.,* 2012).

Total Carbohydrate = 100 - %(Moisture + Ash + Fat + Protein + Fibre).

**Total aerobic plate count (heterotrophic plate count)**

Total aerobic plate count was carried out using pour plate method as described by Kawo *et al.* (2012) and Owolabi and Ichokwu (2014).

## RESULTS

Lettuce and cabbage samples collected from Donga had a higher percentage mean composition of moisture of 96.82±0.52 and 95.41±0.33 (Table 1 and 2). The results of the statistical analysis demonstrated a highly significant difference ($P = 0.001$) in the percentage mean of moisture composition among the various food types from the various locations. Cabbage and lettuce from Jalingo had higher ash percentage mean composition of 0.91±0.054 and 0.99±0.04 respectively. The results of the statistical analysis demonstrated a highly significant difference ($P < 0.05$) in the ash composition of the food samples from each of the four sample locations.

The cabbage sample collected from Jalingo had a higher percentage mean protein content of 0.70±0.88), as shown in Table 1. As shown in Table 2, lettuce sample from Zing had higher percentages of mean protein compositions of 0.85±0.26). Furthermore, based on location, there was a statistically significant difference ($P < 0.001$) in the protein composition of each food sample.

Cabbage from Wukari market had a higher percentage mean composition of lipids (0.60±0.04) (Table 1). In Table 2, lettuce showed a higher percentage mean lipid composition of 0.38±0.02 compared to Jalingo. Based on statistical analysis, there was a

significant difference ($P < 0.05$) in the percentage mean composition of lipid in the food sample from each of the four locations.

Cabbage from Wukari had a higher mean percentage of fibre (3.95±0.10) in its mean composition. (Table 1). Table 2 shows that the percentage mean of fibre in lettuce from Zing was higher at 0.85±0.26. Compared to lettuce, cabbage had a higher mean percentage of crude fibre. While there was no significant difference in the fibre content of lettuce from the four different sampling locations ($P = 0.2835$), the statistical analysis showed that there was a strong significant difference in the fibre content of cabbage from the four different locations ($P = 0.0001$).

The average percentage mean carbohydrate content of the cabbage from Wukari market was 1.80±0.05, (Table 1) and the mean composition of carbohydrates in lettuce was also higher from samples from Wukari (3.94±0.08) (Table 2).

Table 1: Percentage mean proximate composition of fresh cabbage from different sampling locations

| Location | composition | | | | | |
|---|---|---|---|---|---|---|
| | Moisture | Protein | Fibre | Ash | Lipid | Carbohydrate |
| Jalingo | 92.44±0.06 | 0.70±0.08 | 3.53±0.04 | 0.91±0.04 | 0.23±0.02 | 1.20±0.07 |
| Zing | 92.54±0.16 | 0.51±0.04 | 3.60±0.06 | 0.79±0.01 | 0.31±0.02 | 1.53±0.06 |
| Wukari | 95.31±0.32 | 0.57±0.01 | 3.95±0.10 | 0.90±0.02 | 0.60±0.04 | 1.80±0.05 |
| Donga | 95.41±0.33 | 0.51±0.00 | 3.51±0.08 | 0.86±0.02 | 0.39±0.01 | 1.31±0.06 |
| P-value | 0.0001** | 0.0004** | 0.0001** | 0.0001** | 0.0065** | 0.0001** |

Table 2: Percentage mean proximate composition of fresh lettuce from different sampling locations

| Location | composition | | | | | |
|---|---|---|---|---|---|---|
| | Moisture | Protein | Fibre | Ash | Lipid | Carbohydrate |
| Jalingo | 94.95±0.11 | 0.60±0.05 | 0.79±0.02 | 0.99±0.04 | 0.38±0.02 | 3.41±0.05 |
| Zing | 94.21±0.12 | 0.45±0.05 | 0.85±0.26 | 0.93±0.02 | 0.25±0.03 | 3.20±0.09 |
| Wukari | 96.51±0.70 | 0.50±0.03 | 0.78±0.01 | 0.81±0.03 | 0.35±0.01 | 3.94±0.08 |
| Donga | 96.82±0.52 | 0.51±0.04 | 0.75±0.01 | 0.93±0.02 | 0.34±0.03 | 3.71±0.02 |
| P-value | 0.0001** | 0.0001** | 0.2835 | 0.007** | 0.0024** | 0.0204** |

Table 3: Mean values of total bacterial count (TBC) in vegetables from different locations

| Food type | Total No. of Samples | Total bacterial count(cfu/g) | | | | |
|---|---|---|---|---|---|---|
| | | Jalingo(±SEM) | Zing(±SEM) | Wukari(±SEM) | Donga(±SEM) | P-value |
| Cabbage | 100 | $1.44\times10^{7}\pm4.5\times10^{5}$ | $1.46\times10^{7}\pm6.4\times10^{5}$ | $1.40\times10^{7}\pm2.2\times10^{5}$ | $1.56\times10^{7}\pm3.6\times10^{5}$ | 0.4198 |
| Lettuce | 100 | $1.40\times10^{7}\pm6.7\times10^{5}$ | $1.64\times10^{7}\pm4.5\times10^{5}$ | $1.52\times10^{7}\pm4.9\times10^{5}$ | $1.60\times10^{7}\pm5.9\times10^{5}$ | 0.0096** |

The mean total bacterial count was higher in cabbage ($1.56\times10^{7}\pm3.6\times10^{5}$cfu/ml) from Donga and the mean total bacterial count was higher in lettuce ($1.64\times10^{7}\pm4.5\times10^{5}$cfu/ml) from Zing Market (Table 3). There was a significant difference in the mean values of total bacterial count in the food samples ($P < 0.0096$).

## DISCUSSION

Food spoilage by microbial community is greatly influenced by moisture content, which plays a significant role in the distribution of microorganisms in an environment. According to Nwachukwu and Idah (2015), moisture plays a significant role in the growth of microorganisms in food. The average percentage of ash in cabbage was found to be 0.67±0.19 by Tayyeb *et al.* (2017). However, Butnariu and Butu (2014) have reported that the types of nutrients (minerals), crop development, and crop maturation may all have an impact on the significant variation in ash content found in vegetables.

According to Tayyeb *et al.* (2017), the percentage mean protein value of 1.80±051 in cabbage is higher than the percentage mean protein value in cabbage found in this study. Compared to the percentage mean protein value obtained in this work, Caunii *et al.* (2010) reported a higher protein composition in lettuce. The observed variation in the percentage mean composition of protein values among the food items could potentially be attributed to differences in the types of food samples.

According to Caeser *et al.* (2016) and Syamaladeyi *et al.* (2016), foods originating from plants have comparatively lower lipid contents than foods originating from animals, which

could account for the low lipid content of cabbage and lettuce. One possible explanation for the notable disparity in the percentage mean values of lipid in the foods could be due to variations in locations When bacterial cell walls and membranes are developing, lipids are crucial.

According to Tayyeb *et al.* (2017), the percentage mean fibre composition of cabbage in this study is consistent with that of their report. The report by Nwachukwu and Idah (2015), which recorded 1.25±0.10 as the percentage mean composition of fibre in lettuce, is not consistent with the percentage mean composition of fibre in lettuce. $P = 0.2835$ indicates that there was no statistically significant variation in the percentage mean fibre content of lettuce. This may be the case because there are minimal variations in the environmental factors and the lettuce contains the same nutritional components.

The carbohydrate content of lettuce, as reported by Nwachukwu and Idah (2015), does not agreed with the percentage mean carbohydrate content of 6.04±0.22. Microbes use carbohydrates as a primary source of energy, so their presence is significant. This finding supports Januskevicius *et al.* (2012) that vegetables are a good source of carbohydrates.

The degree of contamination in each food sample may be the cause of the significant difference ($P < 0.05$) in the mean values of bacterial counts in the foods in the markets. Numerous elements, such as direct or indirect environmental contamination from sources like soil, water, compost, and excrement, affect the number of bacteria present in food (Zhu *et al.*, 2017).

According to Tiimub *et al.* (2012), there is a growing trend in developing countries such as Nigeria of using untreated water waste and manure as fertilisers on farmlands to produce fruits and vegetables. Contamination can also occur from handling by infected marketers or from vegetables being sprayed with tainted water to keep them fresh in the market (Chukwuma, 2016).

## CONCLUSION

The proximate composition of fresh foods promotes a high microbial load by supporting a high population of microbes. Vegetables should thoroughly be washed and/or cooked before consumption to lower the microbial population.

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