Microorganisms Associated with the Deterioration of Fresh Leafy Indian Spinach in Storage

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Abstract

This work investigated microorganisms associated with the deterioration of fresh leafy Indian spinach. Microbial counts involve the use of pour plate method (PPM). The deterioration, marked by loss of green colour to mushiness of the spinach leaves was caused by a total of four (4) bacterial species and five (5) fungal species. The bacteria isolates were Bacillus subtilis, Serratia marcescens, Lactobacillus sp, and Proteus mirabilis. The fungal isolates were Aspergillus niger, Aspergillus flavus, Mucor mucudo, Fusarium oxysporum and Penicillium sp. The spinach had high moisture content ranging from 90.50% in the white variety (Basella alba) and 90.00% in the purple variety (Basella rubra). The presence of these microorganisms in the leafy spinach indicated microbial contamination, hence spoilage and loss of quality.

Keywords: Deterioration; Spoilage; Contamination; Indian spinach

Introduction

Indian spinach was described as a highly succulent vegetable similar to waterleaf [1]. It belongs to the family basellaceae. The name for spinach is derived from the persian word “ispand” which means “greenhand” and which later became "spanchachia" (Latin), to spinach in English Language [2], of the many spinach cultivars, Indian spinach is the most cultivated in Africa [3]. This is probably due to good environmental factors such as high temperature conditions, high rainfall and moist fertile soils with high organic matter observed in the African continent. The vegetable is cultivated for the use of its leaves and therefore used for soup or stew making. It contains large amounts of ascorbic acid and very rich in mineral substances [3]. In fact, according to Marjorie [5], a serving of 100 grams of Indian Spinach gives 3.2grams of protein, 4.3grams of carbohydrates and 0.3grams of fat together with various proportions of difference mineral elements. Basella alba and Basella rubra were reported as the two major species of Indian spinach in Africa with the former having green stems and green leaves while the latter has purple stems and purple leaves [3]. Spoilage of green leafy vegetable is due to the activity of microorganisms, the condition favourable for their proliferation being moisture and warmth [6].

Eboh and Okoh [6] has worked on microorganisms associated with some common vegetables in Nigeria excluding Basella species. Moreso, Adedayo [7] has equally worked on proximate composition and microbial spoilage of six selected leafy vegetables in South West, Nigeria in which Basella species was excluded out of his research work. Research programmes on leafy vegetables in Nigeria cover only the routinely cultivated ones such as Amaranthus sp (L.), Solanum macrocarpon (L), Celosia argenta (L), Corchorus Oitorius (L), Telfaira occidentalis (F.), Hooks and Hibiscus sabdarifa (L.) [8]. So, there is dearth of information on the spinach vis-à-vis its spoilage and microbes associated with its deterioration. This study therefore, focuses on microorganisms associated with the deterioration of fresh leafy Indian Spinach in storage.

Materials and Methods

Sources of sample

Two species of Basella namely Basella alba and Basella rubra were self – cultivated and hand harvested 90 days after planting. Before use, the fresh leaves were selected for uniformity of colour, smoothness, maturity based on size and kept unpreserved and unprocessed in polyethylene bags for 3 days before investigation. The leaves were stored in the bags according to their species type under ambient storage conditions.


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for 5hrs [12]. The dishes were then removed, covered with lids and allowed to cool in a dessicator before they were weighed to obtain the final weight. This was done in triplicates.

The moisture content of the test sample was then calculated as follows:

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\text{%Moisture content} = \frac{\text{Weight before drying} - \text{Weight after drying}}{\text{Weight before drying}} \times 100
\]

**Discussion**

Table 1 showed the occurrence of bacteria and fungi on the deteriorated leafy spinach. The deterioration according to this work was evident by loss of green colour to mushiness of the leaves and very high microbial count. This is in agreement with the work of Kendal et al. [13] who reported loss of green pigments as a post harvest deterioration of leafy vegetables and microorganisms as agent of deterioration. Hence, the microbial isolates are implicated in the colour change of the leaves.

The various bacteria isolated with the deteriorated leafy spinach samples were Bacillus subtilis, Serratia marcescens, Lactobacillus sp and Proteus mirabilis while the fungal isolates included Aspergillus niger, Mucor mucedo, Aspergillus flavus and Fusarium oxysporum (Table 1). This agrees with reports of Anon [14] that growth and activity of microorganisms principally bacteria and fungi is one of the major causes of deterioration of leafy vegetables. The work of Eboh and Okoh [6] reported Fusarium sp, Aspergillus flavus, Aspergillus niger and Mucor sp as the organisms found associated with decayed leafy vegetables. So, the deterioration of the leafy spinach samples is not unconnected with these isolates.

All the bacterial and fungal isolates were found on both species of the spinach. Table 2 showed the total viable bacterial and fungal count of the spinach samples. The high total viable bacteria and fungal counts in the two species may not be unconnected with the high moisture contents of the spinach (Table 3) and moreso, that the vegetable is rich in vitamins and mineral substances. This validates the reports of Anon [14] that microbes grow in an environment of high moisture contents and nutrients. Thus, the high moisture contents of the Basella species coupled with its richness in minerals and vitamins must have encouraged the growth of this microbe on the spinach leading to its deterioration.

The emergence of the fungal isolates on the spinach samples no doubt suggests possible contaminations by spores in the air, since their spores are numerously available in the air [15]. The isolation of Staphylococcus aureus is indicative of human contamination during handling, since the microbe is known to be a normal flora of man (Onuorah et al, 1987). The presence of Bacillus subtilis, Serratia marcescens, Lactobacillus sp and Proteus mirabilis on the deteriorated spinach samples may be linked to the fact that these microbes are widely distributed in air, dusts and soils.

The high incidence of microorganisms in the spinach samples after the 3-day storage suggests spoilage and loss of eating quality of the spinach. This is in conformity with the reports of Kendall [16] that spinach could only be stored after harvest for one to two days in order to keep its eating quality, otherwise it would perish very quickly. However, the vegetable (Basella species) can be stored for a long time or has longer shelf life if preserved.

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**References**


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