Comparative Studies of the Efficiency of Sun Drying and Hot Air Oven in the Preservation of Pepper and Onion

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ABSTRACT

The drying efficacy and product quality of onion and pepper dried in the oven and sun were compared. The drying process took 1-4 days to accomplish. The proximate analysis, bacterial load and identification of microorganisms, sugar fermentation, catalyses test and the bacteria count were determined. The mean moisture content of the product at the end of the drying was 6.4% (sun) and 4.5% (oven). The oven dried product were significantly (P<0.05) dried than those dried by the sun. The mean value of bacteria load 1g of dried samples from the chambers was 1.65 x 10^5cfu/g (sun) and 1.13 x 10^5Cfu/g (oven). These values were equally significant (P<0.05) from one another. The mean value for the fungal load/g dried sample was 2.50 x 10^4cfu/g (sun) and 1.26 x 10^4cfu/g (oven). The fungal contamination of the samples dried in the oven was significantly less than the sample dried under the sun. Fungal load in oven dried samples had no significant difference in terms of level of contamination.

Keywords: Bacterial loads, Fungal loads, Proximate analysis, Oven and sun drying.

1. Introduction

Vegetable crops such as pepper and onions are perishable crops which deteriorate few days after harvest. Keeping these crops for some months in their fresh state (such as to retain the actual nutrients, taste and colors as when freshly / newly harvested has remained a problem yet unsolved [2]. The

traditional method of drying traditional method of drying crops practiced over the countries throughout the world is sun drying.

This frequently results in poorly dried and infested products since drying under the sun is subject to contamination by dusts, microorganisms, insects, birds, animals and consequently spoilage and quality deterioration [2]. The use of hot air ovens dryers for drying agricultural products in both rural and urban areas will no doubt become important in the sense that cheap and only non-depletable (renewable) energy sources such as solar and wind will be common place unlike electricity or wood- powered drying systems.

Unlike the traditional open air drying systems with or without smoking for items like pepper and onion, the use of hot air oven dryers offer faster, more hygienic and insect and bird free drying package [4], showed that over 50% saving in drying time can be achieved with cheaply constructed hot air oven when compared with sun drying method. The sun drying requires constant exposure to direct sun light during the day and a relative humidity is less than 20% while hot air oven dry is lower than in a dehydrator because ovens do not built in fans for the air movement. It takes two to three times longer to dry food in oven.

Pepper (*Capsicum spp*) is a very important fruit vegetable in the tropics and it is commonly used as condiment. Pepper contributes substantially to the Nigeria diet. It is the main constituent of soups and stems. Nutritionally, pepper supplies the body with vitamins and several minerals nutrient. Agusiobo, in 2003 [1], reported that vitamin C obtain from pepper is greater than that obtain from tomato whenit is adequately supplied with the essential nutrient.

Onion, (*Aliumcepa*) is a biennial crop, storing food in the bulb during the first season and flowering in the second season when the days become long and warm enough. The root system of onion is shallow and fibrous [13]. Onions are grown either as bulb for drying or for pickling as salad onions. When cut or bruised, the characteristics pungent aroma which contains a lachrymatory substance (allicin) is released. Allicin is present in the plant but are formed from odour less saline by enzymatic hydrolysis. Pepper are best stored in the refrigerator. They may be kept there for weeks, if the fresh pods are dried with a clean clothes and placed in an air tight container or a tightly sealed heavy zip lock plastic bag, it is important to remove as much as possible oxygen before placing the tightly closed container is opened, the unused pods must be dried and air remove before resealing and allow it to return to room temperature, then wipe and dry, return to container and sealed. It is also best to freeze pepper [13].

Onions can best be stored in slatted boxes, or tie them together and hang up in bunches in a cool, dry place. Heat or freeze drying alters the odour, flavor and pungency of the manufactured product as it prevents enzymatic activities.

2. Materials and Methods

2.1 Sourse of Sample

The samples of pepper (*Capsicum spp*) and onion *(Allium cepa)* were bought from Ojakoko in Owo town. They were then sorted, washed, cut into uniform thin slices before displaying them on drying trays. Each sample tray was placed in the oven and sun to dry respectively.

2.2 Proximate Analysis

The proximate analysis was determined according to AOAC (1970). It includes moisture content determination, Ash, Crude fibre, protein and fat determination. The moisture content was determined by weighting 2.0 grams of the sample into a previously weighted Crucible, dried overnight at 103^0C – 105^0C to dry to a constant weigh for 24 hours to obtain the residual moisture content and the dry matter [6].

The protein determination was done by determining the nitrogen content and multiplying by 6.25, from the assumption that all food proteins contain 16% Nitrogen (AOAC, 1970). It involves digestion, distillation and titration.

About 1.5 grams of fresh sample was weighed into micro Kyeidahl flask while 0.5g of dried sample was weighed into micro kyeidahl flask, 10ml and 5ml of concentrated H_2 SO_4 was added to the fresh and dried samples respectively and the mixture was heated inside a fume chamber until clear solution was obtained. It was allowed to cool; the digest was made up to 100ml with distilled water and recorded [7].

The distillation was done by putting 50ml of 2% boric acid (H_2BO_3) into 100ml conical flask as receiving flask. The distillate was titrated with standard mineral acid (H_2SO_4) 0.1m (H_2SO_4) until the initial color was observed as end point. Therefore % of crude protein, % of Nitrogen, x 6.25 i.e., % of protein is in Nitrogen.

2.3 Ash Determination

The ash determination was determined by weighing the sample into porcelain crucible, the crucible plus sample were then transferred into the muffle furnace set at 550^0C and left for about four (4) hours. Fat determination was done by weigheing 2 grammes of the fine powdered sample into a fat free extractor thimble andplugged tightly placed in an extractor and petro-ether was added to the flask, which has been previously dried in the oven, cooled in the dessicator and weighed. It was allowed to siphon over and over for eight hours after which the ether was decanted via the condenser until the flask was detached and then dried in an oven to constant weigh. The crude fibre determination was also determined [9].

2.4 Microbiological Analysis of Sample

The serial dilution of the sample were done by weighing 1 gram of the sample into 10ml of sterile distilled water until five fold serial dilution was obtained. The media used are Nutrient Agar (oxoid) for bacterial isolation and popato dextrose agar for fungal isolation. 1ml was pippetted into the petri dishes which has been properly labeled and the media were poured aseptically. The plates were incubated at35^0C for bacteria and room temperature for fungi for 24-48 hours. The various bacteria colonies isolated were sub-cultured to obtain pure culture and were identified based on their colonial morphology, and biochemical characteristics. This includes Gram staining, cata lase test and sugar fermentation in order to tentatively identify the isolates.

TABLE 1: PROXIMATE ANALYSIS OF THE DRIED VEGETABLES SAMPLES (g/100g).

Sample	Sample Dryer	Moisture	Protein	Fat	Fibre	Ash
Onion	Oven dried	5.6	0.9	2.4	2.0	6.0
	Sun dried	8.9	1.2	2.6	2.0	6.2
Pepper	Oven dried	3.8	2.2	3.1	16.8	5.0
	Sun dried	6.1	2.2	3.0	18.6	4.8

TABLE 2: BIOCHEMICAL CHARACTERISTICS OF THE ISOLATES AND MICROBIAL LOAD

Sample	Dryer	Glucose	Mannitol	Lactose	Catalase	Gramstan	Bacterial Load x10^4	Fungi Load	Probable identity	Probable identity
Onion	Oven-dried	A	A	LA	+ve	+ve	15	2	*Staph.aureus*	*A.niger*
	Sun-dried	AG	A	AG	-ve	-ve	22	3	*E.coli*	*R.nigricans*
Pepper	Oven-dried	A	A	LA	+ve	+ve	8	3	*Staph. aureus*	*A.niger*
	Sun-dried	AG	A	AG	-ve	-ve	3	2	*E.coli*	*R.nigricans*

Keys: A = Acid, LA = Late Acid, AG = Acid & Gas, +ve = Positive, -ve = Negative.

3. Results

The results as shown in Table 1, indicate that oven dried onion had 5.6% moisture compared to 3.8% in pepper while the sun dried onion was 89% compared to 6.1% in sun dried pepper. The bacteria

load in oven dried onion was $15x10^4$ compared to $8x10^4$cfu/g oven dried pepper while the sun dried onion had $22x10^4$compared to $12x10^4$ (Table 2). The bacteria load was higher compared to fungi load of $2x10^4$cfu/g (oven dried onion) and $3x10^2$cfu/g for pepper and $3x10^4$cfu/g for sun dried onion and $2x10^4$cfu/g (pepper). The isolates (Table 2) were tentatively identified as *Staphylococcus aureus*, *Escherichia coli* (bacteria) and fungal isolates are *Aspergillusniger* and *Rhizopusnigricans*.

4. Discussions

Pepper showed very high level of crude fibre, as high as 18.6%. The microbial load showed a high bacterial load than fungal load. The bacterial isolates include *Staphyloccusaureus, Escherichiacoli,* while fungal isolates include *Aspergillusniger*and *Rhizopusnigricans;* some of these organisms have been implicated in food poisoning or food infection outbreaks [11]. Some strains of *Escherichia coli* isolates have been implicated in food borne outbreak due to consumption of meat-based snacks which were under cooked [3], [5].

The trend of result also showed that products which were exposed to natural environments (sun dried) were easily contaminated. But under the oven drying chamber, the products were covered and therefore were protected to some degree from contamination. The contamination might be as a result of food handlers or exposure to the environment [3]. It could be as a result of faecal contamination of the water used to wash or from the handlers [8], [10].

5. Conclusion

It showed clearly that the two products can be efficiently dried using oven and sun drying. But comparative evaluation of the performance of the two drying methods, sun and oven, showed that oven drying is better both in terms of drying rate, quality of dried product and low microbial contamination.

6. Authors' contributions

(i). Ojo R.O- Design the material and methods used in the course of the research work.

(ii). Osuntokun O.T –Research into the antimicrobial and phytochemical properties of various medicinal plants and purpose in the south western part of Nigeria & Helps in proof reading, constructive criticism of the manuscript.

(iii). Asubiaro K -Helps to design the introduction and literature review.

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