Post-harvest Sensory Characteristics and Consumer Acceptance of Vegetable Pigeonpea

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Abstract

Pigeonpea (*Cajanus cajan* Milsp) is an important food crop in the dryland tropics. The objective of this research was to evaluate the effects of post-harvest processing and storage on sensory characteristics of pigeonpea. Moisture content of harvested pigeonpeas was assessed at 0. 22 and 60 days of storage. Five treatments of podded, deep-frozen (-18°C), blanched (72°C, 2min), oven-dried (65°C, 8hr), and blanched + oven-dried pigeonpea, in a completely randomized design were evaluated for sensory characteristics at post-harvest storage. The reduction in moisture content was highest (43%) in podded and lowest (6%) on blanched pigeonpea at 60 days of storage. Consumer acceptance of pigeonpea varied significantly ($P < 0.05$) for traits of physical appearance, color, aroma, and seed tenderness. Physical appearance of podded pigeonpea had a sensory rating of 6.3, indicating high acceptability, while blanched samples had a 6.0 rating on a 7-point hedonic scale. The podded, blanched + oven-dried and seed tenderness had 5.6, 6.6, and 6.1 scores, respectively. The sensory scores of podded and oven-dried were attributed to high sugar concentrations (4.25 mg/100g) the samples at 22 days post pre-treatment. Palatability and overall acceptance of pigeonpea were comparable, indicating that post-harvest treatment and 22-day storage had positive sensory attributes. Post-harvest processing treatment and storage may enhance vegetable pigeonpea utilization in the dryland regions.

Introduction

Pigeonpea [*Cajanus cajan* Milsp] is the third most important legume in Kenya, in terms of arcreage of cultivation preceded by dry beans [*Phaseolus vulgaries* L] and cowpea [*Vigna unguiculata* L.] [1]. Most of pigeonpea production in Kenya is concentrated in the Arid and Semi-arid regions of Eastern region, A previous research conducted in Makueni County in that region reported that food consumption patterns were poor, in which 79.1%nof children were malnourished and consumed foods predominantly prepared from maize or other cereals. The high nutrition value of pigeonpeas is the reason for its importance to smallholder farmers in the eastern region of Kenya [2]. Pigeonpea has been utilized as a supplement to the cereals based rural diets which are deficient in protein [2], in the resource-constrained region in lieu of expensive and scarce animal protein.

Pigeonpea is utilized at household level as green vegetable peas, which are shelled manually from the pods [3]. Vegetable pigeonpeas are highly perishable and thus have an inherently short shelf life. Due to lack of post-harvest management options, farmers are forced to sell them in fresh from, which yields lower remunerative price, when there is glut in the local market. Studies on the effect of post-harvest management on vegetables have been reported. [4] observed that storage of shelled short duration pigeonpeas genotypes, at ambient temperatures [21 ± 3^{o}C] led loss ascorbic acid and soluble sugars but increased total titratable acidity. [5] reported that vegetable Soyabean quality, mainly moisture, vitamin C, minerals, sugar changes during cold storage. [6], reported that ascorbic acid, starch and reducing sugars content can be affected when products are frozen. [7] reported a decrease in the initial vitamin C content between 19.1–51.5%, of a number of commercial vegetables, due to processing and freezing, on vitamin

C depending on the type and pre-freezing operations. [8], in a study of green beans, observed that blanching process increased the half-life of ascorbic acid.

Dehydration of vegetable products has been proposed as one of the methods for improving the vegetable shelf life. Drying of food products leads to increased nutrient concentration and retention, reducing final moisture content [9]. Dehydrated products increased the micronutrient concentration in the dried products. This enables the dried products to have a longer shelf life. Traditionally, storage of vegetable pigeonpea in pods is usually practiced by most households, for 3–5 days, as they await transportation to the market. In the urban areas, residents buy the peas and store them under deep freezer or under refrigerator. There are chances that post-harvest management has potential to change the organoleptic characteristics of vegetable pigeonpeas. Sensory panelists give high ratings to cooked seeds with good appearance, taste, and mouthfeel [10]. Surface characteristics of food products contribute to the appearance. [11,12] observed that vegetable pigeonpea, with dark colors were not preferred by consumers and farmers in Kenya.

There is paucity information available on other potential storage options such as dehydration, blanching and deep freezing, in terms of quality deterioration, for vegetable pigeonpeas in Kenya. Improved post-harvest handling and proper storage of vegetable pigeonpeas, can improve quality, preserve food and reduce hunger during recurrent and prolonged droughts in Eastern Region of Kenya. Therefore, the objective of this research was to evaluate the effect of processing and storage on quality, shelf life and consumer acceptance of vegetable pigeonpea [*Cajanus cajan* Milsp]. This has the potential to contribute to improved food security in the Eastern Kenya.

Materials And Method

Description of the study location

The study was carried out at the Kenya Agricultural and Livestock Research Organization's [KALRO] Kiboko station, with planting being done on 7th November 2017, and harvesting done 15th August 2018. The station is situated 2^{o} 10'S and 34^{o}40'E, 975m above sea level, under eco-climatic zone V of Kenya [13]. The mean monthly rainfall ranged from 2.8 in October 2017 to 512 mm in March 2018, realizing a total of 1,207 mm, within 48 rainy days. The rainfall distribution was poor, with first quarter receiving 15% of the total rain, compared to quarter 2 and three, 47% and 38% respectively. Due to poor rainfall distribution at Kiboko, supplementary irrigation was done, which supplied extra 988 mm of water, within 38 times of irrigation. The mean temperature was 24^{o}C, while the mean relative humidity was 83%. Both the rainfall, relative humidity and temperature were within the range required by pigeonpea for growth and development as reported previously [14]. The soils are well drained, very deep, dark reddish brown to dark red, friable sandy clay to clay [Acri-Rhodic Ferrassols] developed from undifferentiated basement system rocks [13;15]. The soil characteristics were within the pigonpea soil requirements for proper growth. Based on previous findings, it has been shown that pigeonpea tolerates pH values of 4.5 to 8.0 for its growth [16].

Description of pigeonpea germplasm

Five medium duration pigeonpea genotypes: ICEAP 00557, ICEAP 00554, KAT 60/8, KIONZA and MZ 2/9, were used in this study. ICEAP 00557 and ICEAP 00554 were originally selected from germplasm collected from Nachingewa in Tanzania by International Crop Research Institute for the semi-arid tropics (ICRISAT). The genotypes flower in about 85-90 days with maturity of 150-160 days. KAT 60/8 flowers in 95-120 days, has plant height of 85-130cm, a spreading growth habit and was developed in Kenya. MZ 2/9 was selected from Mozambique germplasm collection by ICRISAT. It has early flowering, 80-100 cm in plant height, and seed mass of 30-40 g/100 seed. KIONZA is a local genotype grown by many farmers in the Eastern Kenya for both dry and green vegetable peas. The seeds were sourced from ICRISAT's Kiboko and Kambi ya Mawe stations.

Experimental design and field management

The genotypes were planted in a randomized complete block design (RCBD), replicated three times. Each plot had a total of 3 rows and a plot area of $4.5m^2$ with row spacing of 1.5m x 0.3m. Seeds were drilled at a soil depth of 10cm. Agronomic and crop protection measures were done based on cultural practices as recommended for each location [11].

Sample harvest and preparation

Pigeonpea was harvested at 32 days after 50% flowering [Aug 15, 2018]. [17] recommended harvest of green vegetable pigeonpea seeds at 26-32 days after flowering as most of the nutrients are at maximum. The harvested pods [plots and genotypes] were thoroughly mixed to replicate farmer practices in the region. The pods were immediately threshed [~ 20 Kgs of green peas], which were transported to the lab in a cool box (4^oC), based on previous recommendation [4]. A ten kg of sample of un-threshed pods were also transported in a separate cool box container and to the Department of Food Science and Nutrition at University of Nairobi for processing. Pigeonpea samples were placed on aluminum trays to remove damaged and inert materials at ambient condition for 2h prior to experimentation. Threshed pigeonpea was separated into two samples of 5 Kgs each for blanched and un-blanched post-harvest treatments [18;19].

Post-harvest processing of pigeonpeas

The harvested vegetable pigeonpea samples were grouped into five treatments of podded [un-threshed], deep-frozen [fresh un-blanched], blanched, blanched + oven-dried, and oven dried [18]. All treatments were arranged in a completely randomized design with 3 replications. After treatments, samples were stored for 14 days prior to sensory assessment. The treatment descriptions were as follows:

Podded [fresh un-blanched]:

For this treatment, sample was bagged in a polythene bag after air removal by pressing out air [not vacuumed] and stored at room temperature (24^{o}C).

Deep-frozen [fresh un-blanched]:

The samples were bagged in polythene bag followed by air removal from the bag. Vegetable pigeonpea was then stored in a deep freezer at -18C. The frozen samples were thawed and subjected to sensory analyses after post treatment (22 days).

Blanched:

Steam blanching of vegetable pigeonpea was done at the pilot plant in the Department of Food Science and Nutrition, University of Nairobi, Kenya. Pigeonpeas were blanched at 72^{o}C for 2 min, submerged in cold water then drained. A 100g sample was taken for sensory analysis.

Oven-dried:

The fresh vegetable pigeonpea placed in an aluminum tray was dried in the oven at 65^{o}C for 8 hours. After oven drying, samples were evaluated for sensory characteristics.

Blanched + oven dried sample:

Blanched vegetable pigeonpea in an aluminum tray was placed in the oven at 65^{o}C for 8 hours for oven drying. The sample was then stored in a deep freezer for evaluation of sensory characteristics.

Moisture content of pigeopeas

This was determined according to AOAC method specifications by using oven drying [21]. A 3g of sample was weighed in clean, dried crucible [W_1]. The crucible and content were dried in an oven at 100^{o}C for 12 hrs until a constant weight was obtained. The crucible plus content was cooled in a desiccator for 30 mins and weighed again [W_2]. The percent moisture content was calculated at 0, 22 and 60 days of oven drying by the following formula:

Percent moisture [wet weight basis] = [[W_1-W_2]/Weight of Sample]] *100%

Where: W_1=initial weight of crucible+sample; and W_2=final weight of crucible+ Sample

Sensory evaluation of vegetable pigeonpeas

Panelist selection and training

The sensory assessment was used to evaluate acceptability of post-harvest pigeonpeas by panelists based on published methods [22]. Panelists for the sensory evaluation were made up of 7 individuals from the Department of Food Science and Nutrition, University of Nairobi, Kenya. A questionnaire was used to evaluate individual reaction, based on a 7–point hedonic scale was used to quantify the sensory attributes of post-harvest traits as follows: 1 = very highly unfavorable, 2 = highly unfavorable, 3 = moderately unfavorable, 4 = neither favorable nor unfavorable, 5 = moderately favorable, 6 = highly favorable, and 7 = very highly favorable [23 and 24]. The post-harvest traits or characteristics evaluated were appearance, color, taste, aroma [flavor], seed tenderness and overall acceptance. Preliminary screening was done based on knowledge of the desired sensory attributes of vegetable pigeon peas, in a focus group discussion before the actual testing. The panelists were trained on the sensory attributes of vegetable pigeonpea and on the use of appropriate descriptive terms in round-table discussions, prior to the sensory evaluation which was supervised by a panel leader.

Sample preparation

At twenty-two days of storage of post treatment of harvested pigeonpeas, samples of 200 grams were taken from each of the 5 treatments [podded, deep-frozen, blanched, oven-dried, blanched+oven-dried] as previously described [21, 10 and 25]. The deep-frozen storage samples [pigeonpea] were thawed for 20 mins. Pigeonpea samples from pods were threshed and weighed [200g]. The samples were fully cooked to a status of normal softness, based on the household procedure and consumer expectation of what is regarded as a cooked product.

Sensory evaluation

Fully cooked pigeonpeas were evaluated for tenderness [based on chewing], taste, aroma or flavor based on published procedure [26]. Similarly, evaluations were made for appearance and seed color. All samples for sensory evaluations were served at the same temperature and in equal sample size to minimize panel bias. The evaluations were done in the sensory testing room at the Department of Food Science, University of Nairobi. Testers rinsed their mouth after testing each genotype to reduce the lingering taste of the last tested genotype.

Statistical analysis of data

The effect of treatments were evaluated by performing a two-way ANOVA to test the impact of storage duration and treatment methods on sensory characteristics of vegetable pigeonpea samples at 5% level of significance, using by using GENSTAT 15th edition [27]. The mean values of treatment of each parameter were further compared by using the least significant difference [LSD] test at [*P<0.05*] level of probability, using Turkey's method based on SAS Institute 2016, SAS User's Guide Statistics, Cary, NC.

Results And Discussions

Effect of treatment and storage on moisture content

Moisture content was determined before pre-treatment and 22 days, 60 days post treatment. blanched + oven-dried moisture content was reduced by 37%, while oven-dried sample had a 41% reduction of moisture content on a dry weight basis [Figure 1]. Oven dry ing significantly reduced the moisture content in vegetable pigeonpeas. The moisture content in podded sample was reduced by 43% at 60 days of storage at room temperature. [19] reported the moisture content of 11.3% for dried pigeonpea grains. The blanched sample had a low reduction in moisture content of 6%, compared to deep-frozen sample, which had a 17% loss in moisture. This indicates that storage of blanched sample may be expected to have lower moisture loss than deep-frozen one. Moisture loss from samples stored under frozen conditions [-18C] may be enhanced by ice crystals on the surface of vegetables which may sublime into gaseous state leading to water loss when freezer is open. This was the case of dried galega kale [28], in which the vegetable was not packed with water vapor and oxygen proof materials leading to accelerated loss of water as a consequent of increases in storage temperature during freezer door opening.

Sensory evaluation of vegetable pigeonpea

Evaluation of pigeonpea for physical appearance

The un-cooked vegetable pigeonpeas pre-treated and stored for 22 days were evaluated for physical appearance. There was significant difference [*P<0.01*] in appearance among treatments based on the score of panelists (Table 1). [29], reported that the physical appearance of vegetable was strongly affected by storage conditions and duration of storage. The mean sensory score of podded vegetable pigeonpea ranged from 6.3 [high likeability] for physical appearance to 4.4 [neither liked nor disliked] for oven-dried treatment. While treatments of blanched + oven-dried and oven-dried had sensory score values below the overall average of 4.4 and 4.6, respectively; the podded, blanched and deep-frozen samples had higher sensory values for pea appearance. The treatment of podded samples [fresh, un-threshed] had the highest preference with sensory scores of 6.3 [high likeability], followed by blanched [6.0 score] and deep-frozen [5.4 score] treatments (Table 2 and Figure 2).

Table 1

Analysis of variance on the sensory characteristics of post-harvest vegetable pigeonpea at 14 days post-treatment.

Sources of variation	D.f.[a]	Appearance[b]	Color[b]	Odor/ smell[b]	Flavor/ taste[e]	Tenderness[c]	Overall acceptance[c]
Treatment	4	4.83**	7.04**	4.81*	4.53ns	5.54*	1.24ns
Tester	6	4.11ns	5.19ns	2.65ns	4.46ns	2.96ns	2.96ns
Residual	24	0.99	0.98	1.73	2.78	1.68	1.92
$LSD_{[0.05]}$	-	1.10**	1.09**	1.45*	1.84ns	1.43*	1.53ns
CV [%]	-	18.7	19.4	25	34.1	24.8	27.6

[a]Degrees of freedom for the Anova tests.

[b]Visual appeal for seed appearance, color and aroma of vegetable pigeon pea seed as evaluated by randomly selected and trained sensory evaluation panels. Assessment was conducted using hedonic scale of 1-7 where 1= highly unfavourable [dislike] and 7=highly favourable [likable] for a particular attribute.

[c]Evaluation of taste and tenderness subsequent to normal cooking of vegetable pigeon pea and its overall acceptability by a trained panel based on hedonic scale of 1-7 where 1= highly unfavourable [dislike] and 7=highly favourable scale [likable].

* = significant at *P<0.05*; ** = significant at *P<0.01*; ns = non-significant at *P<0.05* based on Turkey's Test.

Table 2

Mean sensory characteristic scores of vegetable pigeonpea subjected to treatment and assessed at 14 days post-treatment.

Sample treatment[a]	Appearance[b]	Color[b]	Aroma[b]	Flavor/ taste[c]	Tenderness[c]	Overall acceptance[c]
Blanched, oven-dried	4.6ab	4.6ab	6.1b	4.5a	4.4a	5.0a
Fresh, podded	6.3c	6.6c	5.9ab	5.7a	6.1a	5.7a
Fresh, blanched	6.0bc	4.7ab	5.1ab	4.7a	5.9a	5.0a
Fresh, deep-frozen	5.4b	5.6b	4.0a	3.7a	5.6a	4.6a
Fresh, oven-dried	4.4a	4.0a	5.1ab	5.6a	4.1a	4.9a
Means	5.34	5.09	5.26	4.89	5.23	5.03
$LSD_{[0.05]}$	1.10	1.09	1.45	1.84	1.43	1.53
CV [%]	18.70	19.40	25.00	34.10	24.80	27.60

[a]Post-harvest treatment of pigeonpea.

[b]Visual appeal for seed appearance, color and aroma of vegetable pigeon pea seed as evaluated by a randomly selected and trained sensory evaluation panels. Assessment was conducted using hedonic scale of 1-7 where 1= highly unfavorable [dislike] and 7=highly favorable scale.

[c]Evaluation of taste and tenderness subsequent to normal cooking of vegetable pigeon pea and its overall acceptability by a trained panel based on hedonic scale of 1-7 where 1= highly unfavorable [dislike] and 7=highly favorable scale [likable].

The means with the same letters within each column are not significantly different [$P>0.05$] based on Turkey's test.

Appearance of vegetable is an important attribute in food choice and acceptance [30]. In this research, scores for pigeonpea appearance was influenced by pea color, as the sample with higher score for color, such as fresh, podded [6.6], also scored highly for appearance [6.3]. In a previous study, high overall sensory acceptance of the beans was closely related to its color [31]. Similarly, podded [fresh] and blanched vegetable pigeonpeas in this study, maintained the green color, which the panelists were accustomed to observing. Therefore, this resulted in high sensory scores that was above average. The consumers of vegetable pigeonpea are familiar with the green color of vegetable pigeonpeas. This typical green color was reduced by dehydration treatment, resulting in lower sensory score. The vegetable appearance was also evaluated based on the pea size. However, oven-drying may have reduced pea size, resulting from moisture loss and producing wrinkled peas. This contributed to unfavorable panel evaluations for pea size subjected to oven treatment. Visual appearance [size and color] of vegetable pigeonpeas influenced consumer evaluations and their choice.

Evaluation of pigeonpea for color preference

The vegetable pigeonpeas [treatment] and stored for 22 days was evaluated for pea color. There was significant difference [$P<0.05$] in pea color among the treatments [Figure 2]. The sensory score for seed color ranged from 4.0 [oven-dried] to 6.6 [podded]. Blanched, blanched + oven dried, and oven-dried pigeonpeas had sensory scores below the average score of 5.09 on a 7.0 hedonic scale. The podded sample had a high sensory score [6.6], followed by deep-frozen [5.6]. compared to the above (Table 2 and Figure 2). The green color of vegetable pigeonpeas is widely considered as an appropriate marker for monitoring physical appearance changes during processes and storage in the whole frozen chain [32]. In the sensory evaluation of broccoli, it was noted that the vegetable color was the most important characteristic influencing consumer choice [32]. Deep-frozen samples maintained the color of vegetable pigeonpeas, while oven treatment impacted the green coloration, leading to poor or low sensory scores. Oven drying treatment adversely impacted the chlorophyll content of pigeonpeas and color change, contributing to lower sensory scores. Some of the color changes in food products have resulted from enzymatic reactions and the release of organic acids from disrupted tissue [6].

Therefore, the thermal processing could lead to loss of the vivid green chlorophyll color, resulting in olive brown color, characteristic of pheophytin. This is ultimately perceived by consumers as a loss of quality. Lower sensory scores of pigeonpea color [4.7 score on a 7.0 scale] was recorded for blanched samples. This could be due to destruction of chlorophyll content of vegetable pigeonpeas by high temperature [72^0C] due to steam blanching treatment. [33] reported that chlorophyll content in peas was reduced gradually as the blanching temperature and time increased. Therefore, blanching treatment may result in reduced consumer appeal and utilization of pigeonpeas.

Evaluation of pigeonpea for palatability

Vegetable pigeonpea subjected to treatments previously described and stored for 22 days were cooked and evaluated for taste. There were no significant differences [$P>0.05$] among treatments based on the sensory scores of trained panelists [Table 1]. This indicates that processing treatments and subsequent storage for 22 days may impact palatability of pigeonpeas. For example, podded samples had the most preference among consumers with a sensory score of 5.7 on a 7.0 scale, followed by oven-dried sample with 5.6 sensory score. Our observations showed that differences in the sensory score of palatability were influenced by total sugars and mineral concentrations, as total sugar content in podded sample was 4.25mg/100g as opposed to 3.14 mg/100g in blanched sample [26% lower than podded] (Table 2 and Figure 3).

The sensory score for blanched sample [4.7] suggest that total sugars may have been affected by blanching, as a 16% reduction of the sugar levels were noted compared to fresh sample after 14 days of storage. It has been observed that higher amounts of sugar content quantified in pea samples may have impacted consumer perception of vegetable pigeonpea in terms of what is perceived as having ideal palatability [34].

Pigeopea evaluation for aroma

Vegetable pigeonpea subjected to various treatments and stored for 14 days and then cooked, were evaluated for aroma. There were significant differences [$P<0.05$] in aroma among treatments. This indicates that aroma trait for can be used as selection criteria for evaluation of treatment effects on cooked vegetable pigeonpea. The sensory scores [hedonic scale] for pigeonpea aroma subsequent to cooking ranged from 4.0 [fresh, deep-frozen treatment] to 6.1 [blanched+oven dried], with a mean value of 5.3 on a 7.0 hedonic scale [Table 1]. While the aroma of deep-frozen samples had significantly [$P<0.05$] lower scores than the average, podded and oven-dried samples were slightly above the average value. The order of preference for aroma sensory scores were: blanched+oven-dried, podded and blanched treatments [Table 2 and Figure 3].

Aroma is an integral part of taste and general indicator of food preference and is an important parameter for acceptability of formulated foods [23]. This research showed that blanched+oven-dried treatment improved the aroma of cooked pigeonpea with values identical to podded [fresh] samples and indicative of consumer preference. The post-harvest treatments that pigeonpea was subjected to is similar to dehydration and may produce a characteristic sweet smell aroma that is preferred by consumers [21 and 9]. Foods of various constituents when subjected to heat treatment [blanched, oven-dried] may produce a wide spectrum of aroma, resulting from degradation of sugar and amino acids and their interactions.

Pigeonpea evaluation for seed tenderness

Cooked vegetable pigeonpea subjected to various treatments and stored for >14 days were evaluated for seed tenderness. There was significant difference ($P<0.05$) in treatment effects on seed tenderness (Table 1). The sensory scores of seed tenderness as evaluated by panelists ranged from 4.1 [oven-dried] to 6.1 [podded] pigeonpea. Seed tenderness of pigeonpea exposed to oven-dried treatment had lower sensory scores compared to the mean (5.01) value. while podded, blanched, deep-frozen and blanched+oven-dried treatments had greater sensory scores than the mean value. The sensory score of seed tenderness was greater in podded sample [score of 6.1 out of 7.0 hedonic scale], than in oven-dried (4.1) samples. Therefore, oven-dried treatment reduced the tenderness of the vegetable pigeonpea more than in other treatments. Post-harvest drying methods have been previously applied to extend the shelf life of food products; however, their effect on the quality of final products may vary [26] (Table 2 and Figure 4).

A common quality defect associated with dehydrated vegetables and food products is loss in texture [35]. This has been mainly due to product exposure to high temperatures, usually in the presence of air during the drying process. The low tenderness score observed in this study could be due to poor textural quality resulting from oven-drying treatment. This has been shown to interfere with the cooking ability of vegetable seeds [36]. For example, thermal treatment resulting in dehydration may lead to reduction in moisture levels in vegetable pigeonpea and subsequent reduction of seed tenderness. It has been shown that green peas dried at 60 watts in a microwave, received low scores, because the hard texture of green peas required high microwave power during drying [37].

Evaluation of pigeonpea for overall acceptance

Vegetable pigeonpea treated and stored for 14 days were evaluated for overall acceptance. There was significant difference ($P>0.05$) in treatment effects based on the sensory scores (Table 1). This is an indication that treatment and storage duration, influenced the overall acceptance of pigeonpea. In this research, the overall acceptance score as a sensory attribute ranged from 4.6 for deep-frozen to 5.7 for podded treatment. The overall acceptability score was greater in podded sample, indicating that this treatment had was preferred in the panelist evaluation. This is similar to results documented in legumes in previous studies [38]. As the sensory characteristics are important for consumer, food products must possess good sensory attributes as evidenced by its overall acceptability [39]. Generally, the podded sample had high scores for its seed tenderness with a score of 6.1 on a 7.0 hedonic scale (Table 2 and Figure 4).

Conclusions

Vegetable pigeonpea is grown extensively in the dryland regions of Kenya. The inadequacy of post-harvest treatment is a contributing factor to under-utilization of pigeonpea low produce price. Post-harvest processing and storage can affect quality, shelf life and consumer acceptance of vegetable pigeonpea. In this study, sensory evaluation results subsequent to processing & storage indicated that seed color, physical appearance and aroma were the main considerations for acceptance of pigeonpea. Dehydration could have resulted in better sensory score due to concentration of minerals in vegetable pigeonpea. Blanching treatment followed by oven-drying had little effect on pigeonpea color, although oven-drying altered its aroma due to oxidation. The sensory scores for seed tenderness, taste and overall acceptance of pigeonpea were favorable following treatments and storage. Enhanced post-harvest processing and management of pigeonpea can improve its utilization and food security in the dry regions of Kenya.

Declarations

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Conflict of Interest

There is no conflict of interest to declare.

Experimental protocol

Permission has been obtained and that all study/experimental protocols involving plant materials was conducted in accordance with ICRISAT, National, and international guidelines and legislation.

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Figures

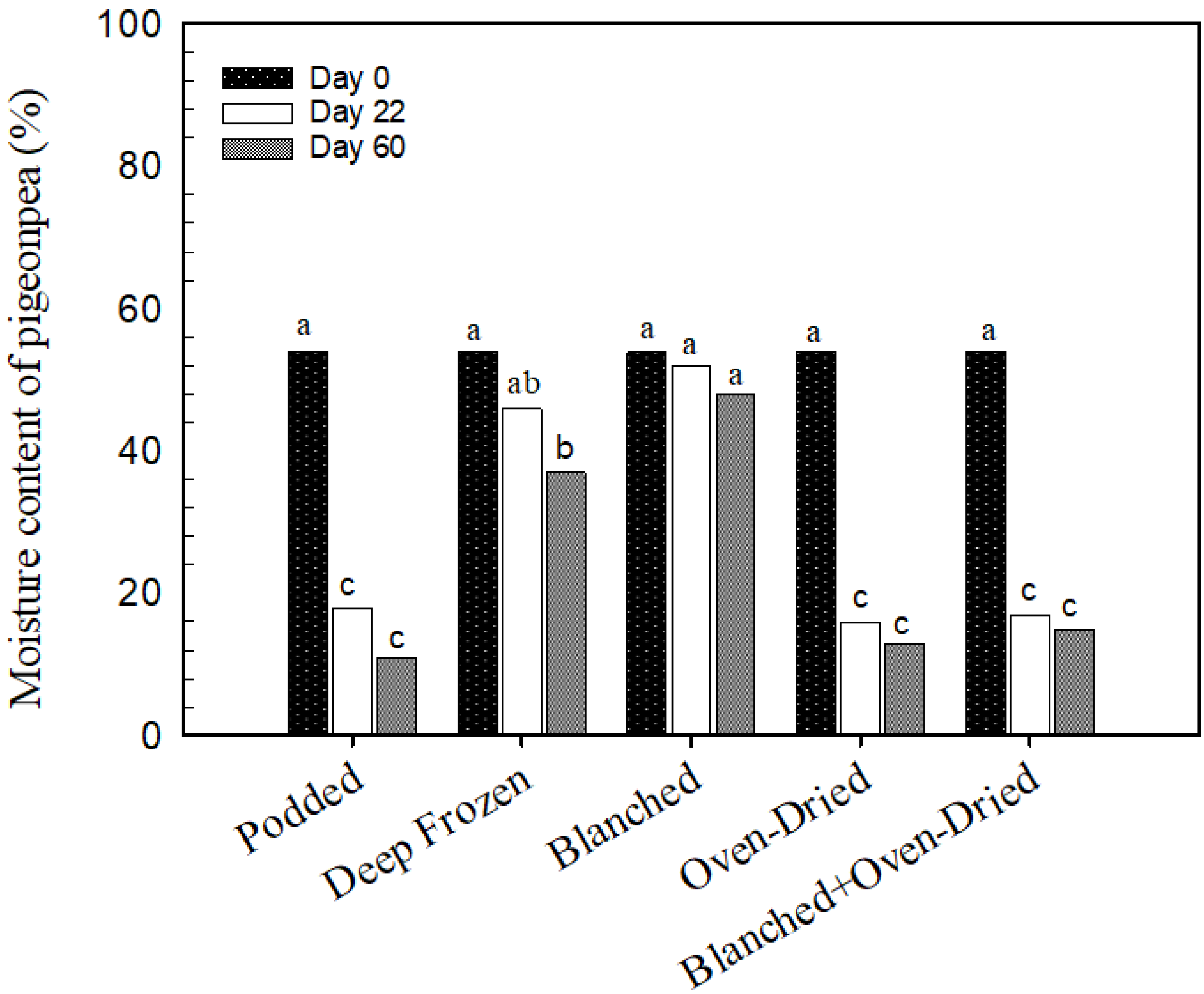

Figure 1

Variation in moisture content of pigeonpea after post-harvest treatment and storage at 0, 22- and 60-days.

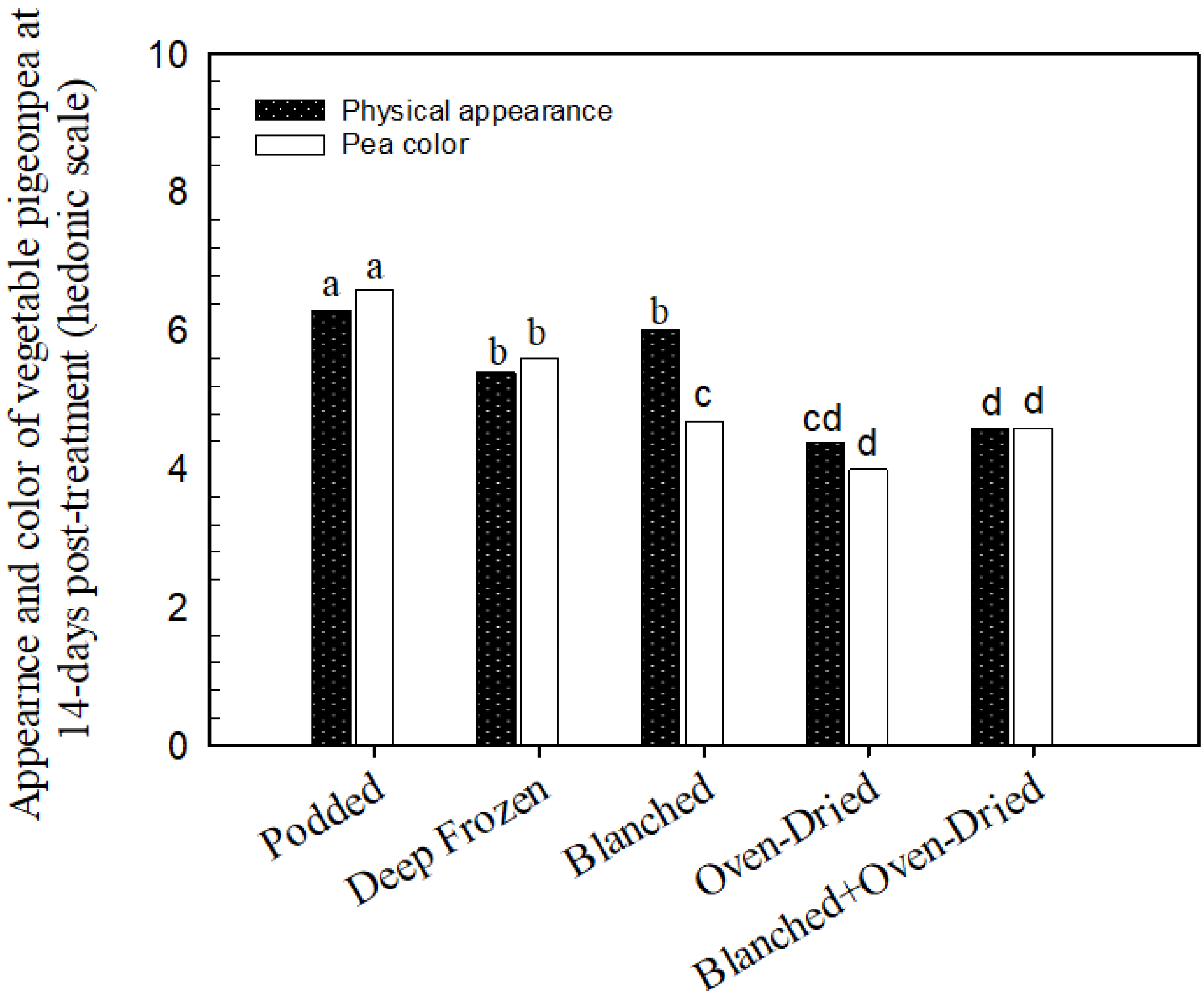

Figure 2

Physical appearance and pigeonpea color sensory characteristics at post-harvest. Evaluation was based on trained panelists on hedonic scales of 1-7 where 1= highly unfavorable and 7=highly favorable.

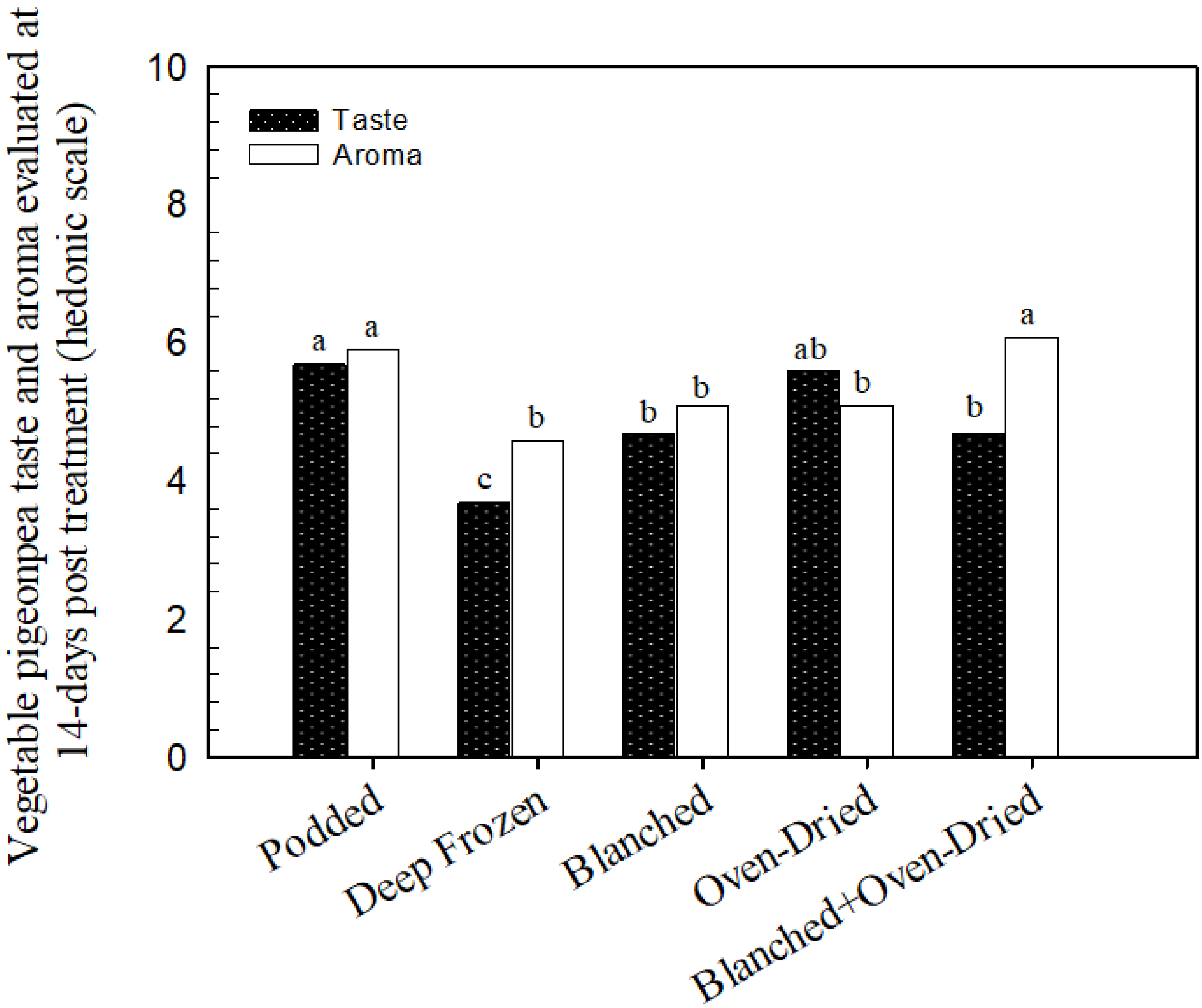

Figure 3

Sensory characteristics of vegetable pigeonpea assessed for taste and aroma after post-harvest treatment. Evaluation was based on hedonic scales of 1-7 by trained panelists, where 1= highly unfavorable and 7=highly favorable for palatability and aroma of cooked pigeonpea.

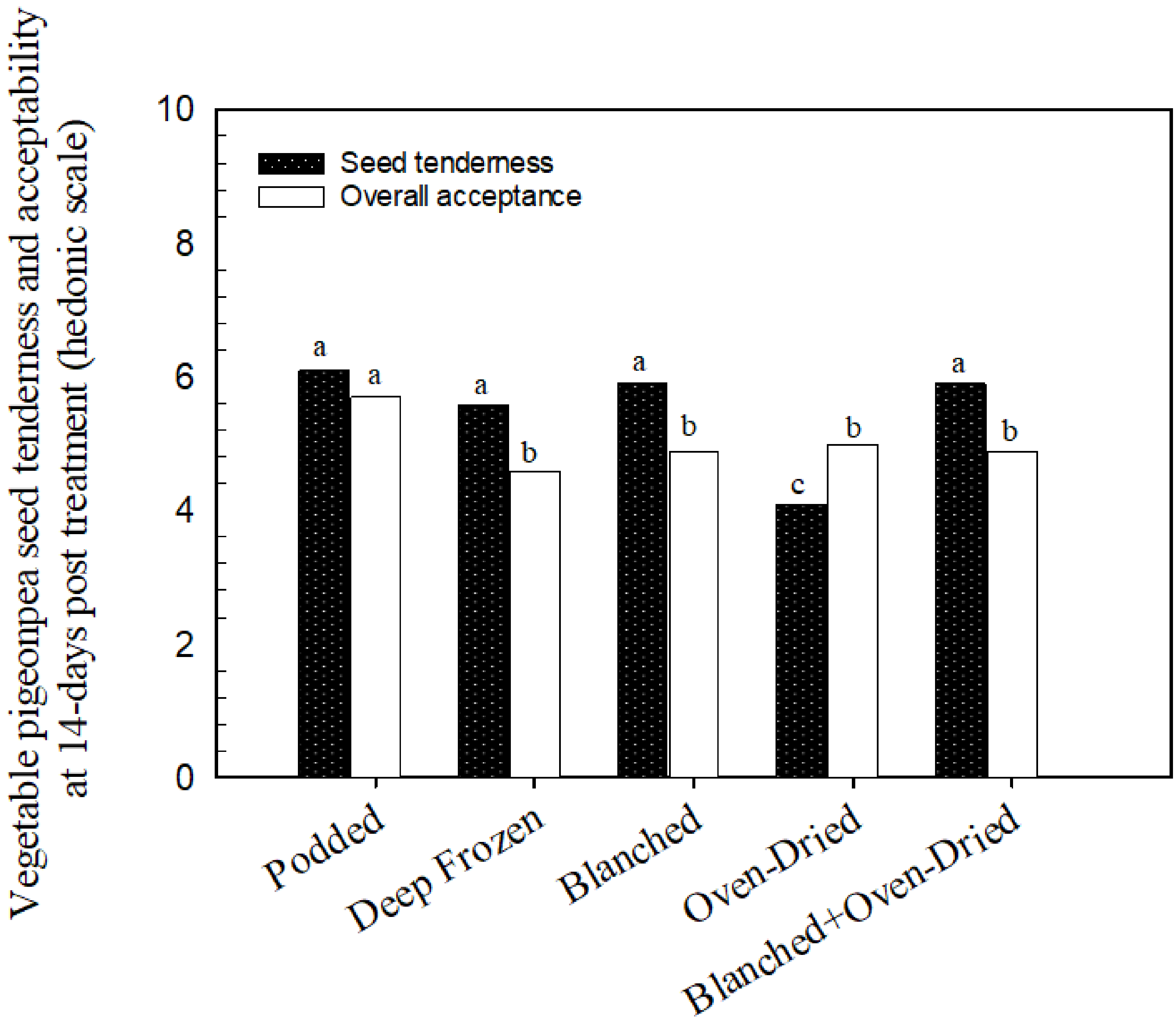

Figure 4

Vegetable pigeonpea assessed for seed tenderness and overall acceptability after post-harvest treatment. Sensory characteristics were evaluated by trained panelists on hedonic scales of 1-7 where 1= highly unfavorable and 7=highly favorable rating for seed tenderness and overall acceptability.