# COOKING TIME, FUNCTIONAL AND ACCEPTABILITY OF GERMINATED, PARBOILED, DRIED, PRESSURE AND MICROWAVE RE-COOKED PIGEON PEA (*CAJANUS CAJAN*) MEAL.

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## Abstract
*Pigeon peas were sorted, germinated; steam parboiled at varied time (20 and 30mins), dried and then re-cooked using pressure cooker and microwave oven with the control sample not parboiled. 10 trained sensory panelists were asked to score for textural changes using 7 point ranking scale with 6.5 as mean score for doneness time. Chemical composition, pH, TTA and functional properties of the meal were determined using standard methods. Consumer panelists of 30 students using 9 point hedonic scale scored for sensory attributes. Results showed that under microwave pigeon peas cooked longer (2h 30min -2h 10min) and pressure cooker (1h 11min -1h) decreasing as parboiling time increased. pH was below pH 7.0 in both cooking methods but microwave had highest values (pH 6.34 – 6.62). In both methods TTA values were not significantly different (P<0.05). Moisture and fat decreased but protein, ash, fiber and carbohydrates increased under pressure cooker than under microwave with both control samples having highest values. Na, P, Zn and Ca, values increased in both cooking methods but pressure cooker values were higher than microwave cooker. Anti-nutritional factors reduced in both cooking methods while pressure cooker increased WAC, OAC, SI, and BD with SC decreasing, but all parameters increased under microwave. Control samples in both cooking method had highest sensory scores followed by 30 minutes parboiled samples. This study showed that pre-germination, parboiling and cooking using pressure cooker reduced time of cooking, improved nutritional values, gives mild acidity, high functionality, and was acceptable.*
**Keywords**: Pigeon pea, Germination, Parboiling, Pressure cooker, Microwave, Quality

## Introduction
Resents studies have suggested that consumption of vegetative foods from legumes that has good fatty acids, high protein, high dietary fibers and less of carbohydrates could be used to combat protein-energy malnutrition in developing countries (Adebowale and lawal, 2004; Gbasdge *et al.*, 2008; Saxena *et al.*, 2010). In the tropics, there exist species of legumes that possess high crude protein content between 22 and 31% like African yam bean (*Sphenostylis sterrocarpa hochst*), Yam bean (*Phaseolus lunatus*), Bambara groundnut (*Vigna subterranean*), pigeon pea (cajanus cajan) e.t.c, (Fasoyiro *et al.*, 2006), but all have low consumption or under-utilization rank probably due to their hard to cook characteristics (Saxena, *et al* 2010). Among these legumes grown in West Africa is pigeon pea (*Cajanus cajan*), commonly named: No eye pea, tropical green pea, gungo pea, 'gandule' bean in Jamaica (Saxana *et al*., 2010) and 'Otili' or 'Otinli', 'Fio-fio' or 'Agbugbu' and Waken-turawa in Yoruba, Ibo and Hausa language of Nigeria, but it is also almost going into extinction (Adebowale & Maliki, 2011). Studies have shown that pigeon peas could be used in fallow land and as fodder plant with edible seeds doing best on medium good soils (Odeny, 2007). Its health benefits are in the areas of its ability to maintain blood pressure, prevent anemia, aids weight loss, helps to boost energy, promotes a healthy hearts, and improves digestive health e.t.c. (Amaefule & Nwangbara, 2004). However, its under-utilization as a food crop in Nigeria has been attributed to its tough texture resulting in long cooking time and lack of knowledge on its nutritional potentials (Mula & Saxena, 2010). In Nigeria it is consumed as a meal when cooked alone or without addition of maize and could be served with stew and with plantain (fried or boiled) and in Jamaica it is used instead of kidney beans in their rice and peas dish (Mula & Saxena, 2010. In order to improve pigeon peas nutritional values germination/sprouting has been recommended (Adebowale & Maliki, 2011). Sprouting enhances the digestibility of legumes through the reduction of indigestible sugars, reducing anti-nutritive compounds, boosting the level and digestibility of free amino acids, increasing mineral bio-availability, improving the functional properties of cereal and pulses (Amaefule & Nwagbara, 2004; Saxena, *et al.*, 2010).

However, information is scanty if germination could assist in reducing the cooking time. To prepare pigeon peas meal in Nigeria, the whole grain is sorted, soaked overnight, cooking in earthen pot or aluminium pot with water added it is placed on firewood stoves pot and under atmospheric condition could cook between 8 – 12 hours leading to high loss of nutrient (Fasoyiro *et al.*, 2010). Today, alternative cooking equipment like pressure cooker and microwave has been shown could reduce time of cooking, consume less energy and could retains more nutrients (Rick *et al.,* 2000; Fasoyiro *et al.,* 2005 Osinboyejo *et al.,* 2011). However, scanty information exists on its usage of pressure and microwave to prepare whole pigeon peas into meal. Therefore, the aim of this study is to evaluate the effects of germination, parboiling time and re-cooking with pressure cooker and microwave on nutritional, functional, recooking time and acceptability of whole pigeon pea (*Cajanus cajan*) meal.

**Materials and Methods**

**Source of Raw material**

Diseased and damaged free pigeon pea were purchased obtained from Sango market in Saki, Oyo state, Nigeria. Equipment such as steamer (Tesco 800 power 3), food dehydrator (Bosch Bs-6605-1550w), and pressure cooker, microwave oven (Domestic type), weighting scale, measuring cylinder, trays, plastic bowls and plastic sieves were obtained from the Department of Food Science and technology, The Oke-Ogun Polytechnic, Saki, Oyo State Nigeria where processing and analysis was done. While all chemical and reagents used for analysis were of analytical grade obtained from registered chemical suppliers in Lagos Nigeria.

**Experimental Design**

**Table 1: Samples Design**

| Cooking Methods | Germinated sample Parboiling Time (Minutes) | Re-cooking Time |
|---|---|---|
| **Pressure cooker** | 0 | X |
| | 20 | X |
| | 30 | X |
| **Microwave Oven** | 0 | X |
| | 20 | X |
| | 30 | X |

**Key:** Control (Germinated), not parboiled;

**Sample Preparation**

**Germination, Parboiling and Drying**

Germination was done using method described by Adebowale & Maliki, (2011). Raw pigeon peas were manually sorted to remove impurities (dirt's, stones, broken, etc), soaked for 6 hours in portable water, spread on sack, covered with old newspaper to germinate for 5-6 days. The sprout seeds as shown in plate 1 were later dried to stop germination and remove shoots. The germinated sample was parboiled at varied time of 20, 30 minutes using electric steamer as shown in Plate 2 while the control was not parboiled. After parboiling the sample was dried in a food dehydrated as shown in Plate 3 until constant moisture content was reached. The dried sample was allowed to cool and was packaged into HDPE nylon bags and was stored in the refrigerator until further usage.

**Re-cooking and Doneness Time determination**

The samples (parboiled and control) were re-cooked in a pressure cooker and microwave oven. The cooked samples (with example shown in plate 4) doneness time was determined during cooking by 10 trained sensory panelists who scored for textural changes using 7 points ranking scale (too hard to too soft). The average ranking score of 6.5 was used and time of sampling was recorded to determine doneness time.

**Plate 1:** Germinated Pigeon pea **Plate 2:** Germinated Pigeon pea Steam Parboiled

**Plate 3:** Pigeon Pea dried in Food Dehydrator **Plate 4:** Pigeon pea re-cooked by pressure Cooker

### 2.2. Analysis of Samples

**Determination of Proximate Composition of Meal Samples**

Moisture, ash, crude fiber, crude fat, crude protein were determined using methods described by (AOAC, 2005). While total carbohydrates was determined by difference using method described by AOAC, (2005).

**Determination of Functional Properties of Meal Samples**

Water holding capacity (WHC), Bulk density (BD), Swelling capacity (SC) and Solubility Index (SI) were determined using the method described by Bayeh and Mangope, (2002); Adebowale and Lawal, (2004); Adebowale and Maliki, (2011)

**Mineral Analysis of Meal Samples**

Phosphorus (P), was determined by atomic absorption spectrometry, Sodium (Na) and Potassium (K) by flame photometry (model: Jernway PFP7 Model) and Zinc (Zn), and Calcium (Ca) were determined using spectrophotometer as descried by AOAC, (2005).

**Determination of pH and Titratiable Acidity (TTA) of Meal Samples**

The pH and TTA were determined according to procedures described by AOAC, 2005). pH was measured with a Thomson pH-38w digital potentiometer. The titratiable acidity (TTA) was established using an alkaline titration (NaOH) and expressed as a percentage of citric acid.

**Determination of Anti-nutritional Factors of Meal Samples**

Tannin was determined using method described by Adeparusi, (2001) of which the absorbance of the Tannic acid standard solution as well as samples were read after color development on a spectronic 210 spectrophotometer at a wave length of 76mm and then percentage Tannin was then calculated. Saponin and phytates values were determined by spectrophotometric as described by by Duhan, *et al.*, (2002). Total Oxalate was determined using method described by Fasoyiro et el., (2006)

**Acceptability Determination of Meal Samples**

Method described by Ihekoronye and Ngoddy, (1985) was used for sensory evaluation of samples by 30 students as consumer panelist who are familiar with consumption of pigeon peas as a meal. They were asked to evaluate the samples products by using 9 point hedonic scale for appearance, aroma, taste, texture and overall acceptability

**Statistical Analysis**

The data were reported in triplicate and was analyzed using SPSS, version 20.00. The mean and standard error or mean (SEM) of the triplicate analysis was calculated. The analysis of variance (ANOVA) was done and significant differences was between the mean ($P < 0.05$) at 5% level of significant. While the mean was separated using the new Duncan multiple range test (DMRT).

**Results and discussion**

**Table 2: Re-cooking time of Meal Samples**

| Sample | Re-cooking Time (Hours) |
|---|---|
| Pressure Cooked Control | 1 h 11mins |
| Pressure Cooked Parboiled (20mins) | 1h 4mins |
| Pressure Cooked Parboiled (30mins) | 1h 00mins |
| Microwaved Control | 2h 30mins |
| Microwaved Parboiled (20mins) | 2h 20mins |
| Microwaved Parboiled (30mins) | 2h 10mins |

Significant different is at $p<0.05$. Sample composition was calculation in wet basis;

**Discussion**

The re-cocking time in table 2 above shows that using microwave cooker gave longest time (2h 30min – 2h 10min) than pressure cooker (1h 11min – 1h 00min) which decreased as the parboiling time increases with the control sample having highest value (2h 30min) the control sample had highest time in pressure cooker (1h 11min) and 2h 30min in microwave cooker. Parboiling and drying of rice and other grains has been used to reduce time of cooking which pre-gelatinized it starch when exposed to heated steam or water (Fasoyiro *et al.,* 2005). While studies have shown that pressure cooker and microwave uses less energy and reduce time of cooking (Wang and Weller, 2006). Also, germination must have contributed to reduce cooking time due to the breaking down of its carbohydrates and protein during sprouting (Amaefule & Nwagbara, 2004).

**Table 3: Physico-chemical properties (pH and TTA) of Meal Samples**

| Sample | pH | TTA (mg/100g) |
|---|---|---|
| Pressure Cooked Control | $6.24{\pm}0.02^{a}$ | $0.06{\pm}0.00^{ab}$ |
| Pressure Cooked Parboiled (20mins) | $5.90{\pm}0.02^{b}$ | $0.07{\pm}0.00^{b}$ |
| Pressure Cooked Parboiled (30mins) | $6.30{\pm}0.00^{c}$ | $0.06{\pm}0.00^{a}$ |
| Microwaved Control | $6.34{\pm}0.05^{a}$ | $0.04{\pm}0.00^{a}$ |
| Microwaved Parboiled (20mins) | $6.56{\pm}0.00^{b}$ | $0.05{\pm}0.01^{b}$ |
| Microwaved Parboiled (30mins) | $6.62{\pm}0.00^{c}$ | $0.06{\pm}0.01^{c}$ |

Significant different is at $p<0.05$. Sample composition was calculation in wet basis;

**Discussion**

Table 3 above shows the result of pH and Titritiable acidity (TTA). The pH of the meal samples under pressure and microwave cooking have a mild acidic value closer to the neutral pH 7. The pH under microwave had higher values (6.34 – 6.62) than under pressure cooker (6.24 -6.30). Also, the pH values increased as the parboiling time increases in both cooking methods with the 20min sample having lower pH under pressure cooker (5.90) and higher value in 30min sample under microwave (6.62). While TTA values were not significantly different ($p<0.05$) in both cooking methods but the control and 30min samples had higher value in pressure cooker (0.06mg/100gm) and lowest value in microwave (0.04mg/100gm). PH and titriteable acidity measure the hydrogen ions concentration of the food and it is a factor often used to determine microorganism growths in which acidic level (pH 1-7) and alkaline level (pH 7-14) could hinder growth and since this meal is mild acidic, there is the possibility of low microbial growth.

**Table 4: Proximate Composition of Meal Samples (wet basis)**

| Sample | Moisture (%) | Protein (%) | Fat (%) | Ash (%) | Fiber (%) | Carbohydrates (%) |
|---|---|---|---|---|---|---|
| Pressure Cooked Control | 63.00±1.32[b] | 8.52±0.03[a] | 3.00±1.00[a] | 2.57±0.12[a] | 0.98±0.00[a] | 21.94±1.39[b] |
| Pressure Cooked Parboiled (20mins) | 63.17±0.76[b] | 9.08±0.03[b] | 2.67±0.58[a] | 5.30±0.26[b] | 1.05±0.01[b] | 18.74±0.76[a] |
| Pressure Cooked Parboiled (30mins) | 56.33±0.29[a] | 10.88±0.02[c] | 2.00±0.00[a] | 5.23±0.64[b] | 1.25±0.00[c] | 24.30±0.95[c] |
| Microwaved Control | 71.33±0.29[b] | 8.57±0.01[a] | 1.00±0.00[a] | 4.07±0.40[a] | 0.96±0.00[a] | 14.06±0.64[a] |
| Microwaved Parboiled (20mins) | 69.58±0.76[a] | 9.89±0.04[c] | 2.00±0.00[a] | 3.50±0.50[a] | 1.11±0.00[c] | 13.91±0.78[a] |
| Microwaved Parboiled (30mins) | 69.75±0.25[a] | 9.19±0.03[b] | 2.00±0.00[a] | 3.73±0.40[a] | 1.03±0.00[b] | 14.30±0.49[a] |

Significant different is at p<0.05. Sample composition was calculation in wet basis;

**Discussion**

Table 4 above shows proximate composition of meal samples. Moisture values is higher in microwave (71.33% - 69.75%) than in pressure cooker (63.17 – 56.33%) with values decreasing as the parboiling time increased. As the parboiling time increased under pressure cooker, protein increased (8.52 -10.88%), fat decreased (3.00 – 2.00%), ash increase (2.57 – 5.30%), fiber increased (0.98 - 1.25%) and carbohydrate increased (21.94 – 24.30%) with the control having the lowest values compared to 30 min sample with highest value. Under microwave cooking as the parboiling time increased, protein increased (8.57 – 9.19%), fat increased (1.00 - 2.00%), ash decreased (4.07 – 3.73%), fiber increased (0.96 – 1.03%) and carbohydrates increased (14.06 – 14.30%). The control sample had higher values ash (4.07%), lowest values of protein, fat and fiber compared to 20 min parboiled sample with highest values of protein, fat, fiber, and 30min sample with highest value of ash and carbohydrates.

In food storage, moisture availability could aid microbial growth and enzymatic action (Adebowale and Maliki, 2011) while protein quality is often enhanced by heat application (Bressani, 1975) and the value obtained might have been contributed by germination and heating methods (parboiling, pressure cooker and microwave) lower fat content might have been contributed by severity of heat from parboiling and cooking methods making it suitable for the obsessed. The higher nutritional values in pressure cooker than microwave cooker could have been contributed by short heating period in pressure cooker than in microwave. While germination and parboiling also enhance fiber content in foods (Osinboyejo *et al*., 2011) and consumers could earnest its numerous health benefits. (Amaefule and Nwagbara, 2004). Low carbohydrates values in microwaved samples might be as results of long cooking hours than pressure cooker which had hydrolyzing effects on starch (Bressani, 1975; Zakpaa *et al*., 2010).

**Table 4: Mineral composition (mg/100g) of Meal Samples**

| Sample | Sodium (mg/100g) | Potassium (mg/100g) | Phosphorus (mg/100g) | Zinc (mg/100g) | Calcium (mg/100g) |
|---|---|---|---|---|---|
| Pressure Cooked Control | 345.31±0.00[a] | 279.81±14.07[a] | 437.07±21.98[a] | 1.02±0.05[a] | 236.84±0.00[a] |
| Pressure Cooked Parboiled (20mins) | 470.81±0.00[b] | 399.09±5.59[b] | 623.38±8.73[b] | 1.45±0.02[b] | 322.92±0.00[b] |
| Pressure Cooked Parboiled (30mins) | 605.61±8.05[c] | 482.95±11.18[c] | 754.37±17.47[c] | 1.75±0.04[c] | 415.37±5.52[c] |
| Microwaved Control | 289.53±13.95[a] | 502.13±13.57[a] | 597.04±16.14[a] | 1.03±0.03[a] | 200.08±5.41[a] |
| Microwaved Parboiled (20mins) | 326.71±8.05[b] | 556.99±11.76[b] | 662.26±13.98[b] | 1.14±0.02[b] | 221.94±4.68[b] |
| Microwaved Parboiled (30mins) | 359.25±24.15[c] | 584.42±35.91[c] | 694.88±42.70[c] | 1.20±0.07[c] | 232.87±14.31[c] |

Significant different is at p<0.05. Sample composition was calculation in wet basis;

**Discussion**

The result from table 4 shows the mineral composition of the pigeon pea meal increased as the parboiling time increased in all the cooking methods. Comparing pressure and microwave cooked meal, Na, Zn and Ca had lowest value under pressure cooker and K and P had highest value under microwave cooking. The control samples had lowest value under both cooking methods compared to the parboiled samples. In foods, sodium add to taste but humans body required a small amount (500mg daily) and if exceeded leads to high blood pressure, heart disease and stroke and calcium losses (Brown *et a*l, 2019). While Potassium assists to maintain normal levels of fluids inside our cell, support muscles contract and normal blood pressure thus reducing blood pressure and heart related problem (Yang et al., 2011; Alfarasi and Lee, 2011). Phosphorus content has been shown could assists in formation of bones and teeth and metabolism and assimilation of carbohydrates and fats in human body (Duhan et al., 2002). While Zinc is needed for immune system to properly work, cell division, cell growth, wound healing and metabolism of carbohydrates (Markell and Sidiqi, 2020). Calcium assist in bone and teeth developments and also plays role in blood clottting, helping muscle to contract and regulate normal heart rhythms and nerve functions and its deficiency can cause rickety in growing children (Rama and Neild, 2019).

**Table 5: Anti-nutritional composition (mg/100g) of Meal Samples**

| Sample | **Saponin (mg/g)** | **Oxalate (mg/g)** | **Tannin (mg/g)** | **Phytate (mg/g)** |
|---|---|---|---|---|
| Pressure Cooked Control | 0.02±0.02[a] | 0.52±0.01[c] | 0.27±0.02[a] | 1.15±0.02[c] |
| Pressure Cooked Parboiled (20mins) | 0.04±0.00[b] | 0.44±0.01[b] | 0.32±0.03[b] | 0.99±0.02[b] |
| Pressure Cooked Parboiled (30mins) | 0.02±0.01[a] | 0.38±0.02[a] | 0.26±0.02[a] | 0.85±0.03[a] |
| Microwaved Control | 0.16±0.01[b] | 0.23±0.04[a] | 0.28±0.04[a] | 1.02±0.01[c] |
| Microwaved Parboiled (20mins) | 0.26±0.02[c] | 0.21±0.02[a] | 0.26±0.02[a] | 0.98±0.01[b] |
| Microwaved Parboiled (30mins) | 0.11±0.01[a] | 0.18±0.04[a] | 0.22±0.05[a] | 0.95±0.02[a] |

Significant different is at p<0.05. Sample composition was calculation in wet basis;

**Discussion**

Table 5 above showed the anti-nutritional value of the samples decreasing in both cooking methods as the parboiling time increased. Under pressure and microwave cooking, methods, saponnin had higher value in 20 minutes parboiled sample (0.04mg/g and 0.26mg/g) respectively. Oxalate, tannin, and phytate decreased in pressure and microwave cooking methods as the parboiling time increased. While microwave showed lowest reduction of oxalate than pressure cooker. The lowest values of anti-nutrients recorded must have been contributed by germination (Amaefule & Nwagbara, 2004; Saxena, *et al.*, 2010) and heat from parboiling and cooking methods (Tabekhia, et al, 1980). These lowest values in microwave and highest value in pressure cooker could have been as a result of long cooking time and short cooking time respectively. This decrease shows that the meal will have little or no impairment on metabolism (absorption and assimilations) of minerals in human diets (Ramakisna, *et al.*, 2006).

**Table 6: Functional properties of Meal Samples**

| **Sample** | **Water Absorption Capacity (%)** | **Oil Absorption Capacity (%)** | **Swelling Capacity (%)** | **Solubility Index (%)** | **Bulk Density (g/ml)** |
|---|---|---|---|---|---|
| Pressure Cooked Control | 123.67±1.15[a] | 90.00±1.00[a] | 5.94±0.21[c] | 22.48±0.21[a] | 0.88±0.02[a] |
| Pressure Cooked Parboiled (20mins) | 127.00±1.00[b] | 91.00±1.00[a] | 5.27±0.09[b] | 23.09±0.18[b] | 0.90±0.01[ab] |
| Pressure Cooked Parboiled (30mins) | 129.67±2.08[b] | 93.67±3.06[a] | 4.73±0.16[a] | 23.58±0.38[b] | 0.93±0.03[b] |
| Microwaved Control | 131.33±1.53a | 81.00±1.00a | 5.67±0.08a | 17.33±1.15[a] | 0.91±0.01[a] |

| | | | | | |
|---|---|---|---|---|---|
| Microwaved Parboiled (20mins) | 142.33±6.51c | 83.00±1.00a | 6.23±0.28b | 37.00±1.00$^{b}$ | 0.93±0.01$^{a}$ |
| Microwaved Parboiled (30mins) | 140.00±5.20b | 86.67±2.08b | 5.76±0.13a | 37.67±0.58$^{b}$ | 0.97±0.02$^{b}$ |

Significant different is at $p<0.05$. Sample composition was calculation in wet basis;

**Discussion**

Table 6 above indicates the functional properties of the samples meal compared the cooking methods there is higher values of WA, SC, SI AND BD in microwave cooking and OAC in pressure cooker and as the parboiling time increases. Under pressure cooking WAC increased (123.67 – 129.67%), OAC increased (91.00 – 93.67%) SC decreased (5.94 – 4.73%), SI increased (22.48 – 23.58%) and BD increased (0.88 – 0.93g/ml). The control samples had the lowest values compared to the parboiled samples. While under microwave cooking WAC increase (131.33 – 140.00%), OAC increased (81.00 – 86.67%), SC increased (5.67 – 6.23%), SI increased (17.33 – 37.67%) and BD increased (0.91 -0.97g/ml) and the control samples had lowest value compared to the parboiled samples. Water absorption measures the amount of water absorbed by starchy food when soaked in water. These results shows that severity of heat could have effect on functional properties of food (Chau and Cheung, 1998) and Bulk density is influenced by the structure of starch polymers and loose structure of the starch polymers and could have effect on this result in low bulk density (Chikwendu, 2007).

**Table 7: Sensory Evaluation of re-cooked Meal Samples**

| **Sample** | **Appearance** | **Texture** | **Taste** | **Mouth Feel** | **Color** | **Flavor** | **Overall Acceptability** |
|---|---|---|---|---|---|---|---|
| **Pressure Cooked Control** | 7.92$^{b}$±0.28 | 7.56$^{b}$±0.26 | 7.36$^{a}$±0.29 | 7.56$^{b}$±0.14 | 7.56$^{b}$±0.26 | 7.92$^{b}$±0.28 | 8.08$^{b}$±0.14 |
| **Pressure Cooked Parboiled (20mins)** | 5.40$^{a}$±0.31 | 6.20$^{a}$±0.37 | 6.20$^{a}$±0.33 | 6.04$^{a}$±0.36 | 6.20$^{a}$±0.37 | 5.40$^{a}$±0.31 | 6.68$^{a}$±0.20 |
| **Pressure Cooked Parboiled (30mins)** | 6.28$^{b}$±0.27 | 6.68$^{ab}$±0.28 | 6.32$^{a}$±0.21 | 6.12$^{a}$±0.32 | 6.68$^{ab}$±0.28 | 6.28$^{b}$±0.27 | 6.88$^{a}$±0.21 |
| **Microwaved Control** | 5.40$^{a}$±0.31 | 6.28$^{b}$±0.27 | 6.92$^{b}$±0.26 | 6.84$^{b}$±0.22 | 6.28$^{b}$±0.32 | 8.08$^{b}$±0.14 | 7.08$^{b}$±0.14 |
| **Microwaved Parboiled (20mins)** | 6.20$^{a}$±0.37 | 6.68$^{ab}$±0.28 | 6.68$^{ab}$±0.32 | 7.04$^{ab}$±0.03 | 6.56$^{a}$±0.32 | 6.68$^{a}$±0.20 | 6.58$^{a}$±0.20 |
| **Microwaved Parboiled (30mins)** | 6.68$^{a}$±0.20 | 6.88$^{a}$±0.21 | 7.32$^{a}$±0.19 | 7.08$^{a}$±0.27 | 6.96$^{a}$±0.27 | 6.88$^{a}$±0.21 | 6.30$^{a}$±0.21 |

Significant different is at $p<0.05$. Sample composition was calculation in wet basis;

**Discussion**

Table 7 above indicates the sensory properties of re-cooked pigeon pea using pressure and microwave cookers. The control sample had highest values in terms of appearance, taste, mouth feel, colour, flavor and overall acceptability compared to the parboiled samples under pressure cooking. While under microwave, the control had lowest value under appearance, texture, taste, mouth feel and color except under pressure cooking in flavor and compared to the parboiled samples as the parboiling time increases. Under pressure cooking appearance ranking decreased (7.62 – 6.28), texture decreased (7.56 -6.68) and taste, mouth feel, color, flavor and overall acceptability decreased. While under microwave cooking appearance ranking increased (5.40 – 6.68), Texture increased (6.28 – 6.88), and taste, mouth feel, color increased, but flavor and overall acceptability decreased (8.08 – 6.88 and 7.08 – 6.30) respectively. In overall acceptability consumer scored the pressure cooked control samples highest ranked followed by 30 min parboiled sample.

**Conclusion**

These results shows that the application of germination and parboiling with cooking in pressure cooker will present a meal high in nutritional composition, reduced anti-nutritional value, high functional properties with reduced cooking time as well acceptability by consumers compared to the traditional processing methods for pigeon peas This will contribute to assist household to continue getting its nutritional benefits when this pre-processing pathway of processing.is followed.

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