Effect of canning on color attributes and Bioactive Compounds of Maz-type common bean Lines

Milkesa Feyera
Melkassa Agricultural Research Center, Ethiopian Institute of Agricultural Research, Ethiopia
Corresponding Author: milkesafeyera4@gmail.com

Abstract

Common beans with good retention of color and bio active compounds after canning are desirable for consumers, canning industry, and other end users. The objectives of this study was to evaluate maz-lines common beans for their retention of color and bio active compounds during canning process. Color attributes and bioactive components of maz-type canned common beans were evaluated using standard official methods. The result showed that yellowness and lightness color attributes were improved by canning process for maz-type common bean lines. On the other hand, good retention of phenolic and flavonoids were demonstrated in samples soaked at ambient temperature for 30minutes and blanched at 75 °c and 88 °c for 30 minutes.

Key words: Blanching, Canning, Color, Soaking, phenolic, flavonoids
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Introduction

Dry beans are rich in proteins, certain carbohydrates, good in minerals and fiber. It also contains some anti-nutritional compounds that interfere nutrient digestibility and absorption in human body. Those anti-nutritional compounds are considered as bio active components which has a role for preventing coronary heart disease, type II diabetes and obesity. Each bean type have unique minor chemical profiles and affected their functional food outcomes. Some common beans type contain non nutritive proteins that displays insecticidal properties against bean bruchids. Brichids are small beetle and major post harvest pest of stored legumes that can cause a significant post harvest losses. Maz-type common beans have remarkable bruchids resistant properties and have been used as breeding materials to generate improved multipurpose common beans .

Common beans must be processed prior to consumption. These processes change the nutritional composition and bio active compounds. Canning is a conventional food preserving method in which the food product is sterilized by heat after placed in hermetically sealed containers (De Lima Sampaio *et al*., 2022). Canning process includes soaking, blanching and autoclave cooking operation. These contributes some improvements in nutritional profile, enhance flavors to beans, reduce heat-labile anti-nutrients, and elongate storage life of canned foods. There are maz-type bean lines developed for canning purpose but their canning attributes, color retention and bioactive components were not known after canning. Therefore, the objectives of this study was to evaluate color attributes and bioactive components of maz-type canned common beans.

Materials and Methods

Sample collection and Preparation

Common beans of MAZ types, a total of 3 lines were collected from melkassa agricultural research center and transported to food science and nutrition research laboratory. The sample was cleaned, washed and sorted manually to remove all, extraneous materials. Then, the cleaned all maz-type common beans were subjected to

different canning treatments. Consequently, three maz- lines were tested under different canning steps shown in Table 1 and evaluated for their color attributes and bio active compounds.

Table1: Treatment combination of an experiment

Treatments	Soaking and blanching time in minute	Blanching temperature in ^{o}c	Thermal processing (temp*time)
1	20	60	115.6*45
2	20	75	115.6*45
3	20	88	115.6*45
4	30	60	115.6*45
5	30	75	115.6*45
6	30	88	115.6*45
7	40	60	115.6*45
8	40	75	115.6*45
9	40	88	115.6*45

Canning procedure

Seed samples of MAZ-type common bean lines were cleaned and sorted manually to remove the under sized and broken seeds. The cleaned and sorted seed samples of each bean lines were stored in separate airtight containers until analyzed for their color attributes and bio active compounds. Cleaned seed samples were subjected to the modified laboratory canning procedure described by (Balasubramanian, 1998). About 96 g from each Maz-type common beans were weighed in clean plate and transferred to mesh bags. Those weighted seeds were soaked in distilled water (1:3 gram to mililiter (mL)) for 20, 30 and 40 minutes at room temperature.

Then, blanched for above set time and temperature combination in water containing 10 mg Ca2+ kg–1 (10 ppm), as calcium chloride dihydrate. The seed samples in the bag were cooled in cold water, drained and weighed. The weight gained by imbibitions during soaking was used to calculate the hydration coefficient. Weighed, the seed sample from each mesh bag was transferred to bottle cans. The cans were filled with brine (prepared using deionized water with a calcium level the same as that of the soak and blanch water) containing 1.3% (wt/vol) NaCl and 1.6% (wt/vol) sugar, sealed, and processed in retort autoclave using steam at 115.6°C for 45 min and then cooled in water at 20°C for 20 min.

Colour (C): Colour attributes of the raw and canned maz-type common bean samples were estimated by using Hunter lab calorimeter (Hunter Lab, ARS00073). Colour scale values were measured using three international color units, such as L* indicates lightness and extends from 0.0 (black) to 100.0 (white), a* refers redness (+value) to greenness (-value) and b* represents yellowness (+value) to blueness (-value) (Hunter Lab, 2013).

Determination of bio active compounds

Total polyphenolic content

The total polyphenolic compounds of extracts was determined with the folin-ciocalteu reagent (Singleton *et al.,* 1999) by using UV spectrophotometer. 100 µL of a crude extract (10 mg/ml) was mixed with 0.2 ml folin-ciocalteu reagent (1: 9 ml distilled water ratio), 2 ml purified water, and 2 ml of 7.5 % Na_2CO_3. The mixture measured at 765 nm after 2 hours at room temperature. Different concentrations of Gallic acid used as a standard. Various concentrations of Gallic acid solutions in methanol (0.005, 0.01, 0.02,0.04, 0.08, and 0.1 mg/ml) was prepared from the standard solution. To each concentration, 0. 2 mL of 10% Folin–Ciocalteu reagent (FCR), 2 ml purified water and 2 mL of 7.5 % Na_2CO3 will be added making the final volume of 4.3 mL. The total polyphenolic compounds was calculated and expressed as mg Gallic acid equivalent (mg GAE/g) sample. The measurement was performed in triplicate and calculated using below formula.

$$C\ (mg/g, \text{in GAE}) = C_1 * V/m$$

where C = total polyphenolic content in mg/g, in GAE (Gallic acid equivalent), C_1 = concentration of Gallic acid established from the calibration curve in mg/ml, V = volume of extract in mL, and m = the weight of the plant extract in g.

Total Flavonoids

Flavonoids content of the flour samples was determined using the UV spectrophotometer method (Quettier *et al*., 2000). Two (2ml) of the extracted sample (extracted with 80% acidic methanol) with concentrations of 10mg/ml was mixed with an equal amount of 2% $AlCl_3$ solution in methanol. Then the mixed solution was incubated for 1 hr at room temperature (RT). Different concentrations of quercetin solution used as standard and methanol is used as a blank while reading the absorbance using a spectrophotometer at λmax =415nm. Based on the measured absorbance, the concentration of flavonoid was read (mg/mL) on the calibration line, and then, the content of flavonoid in each sample was expressed as a term of Quercetin equivalent (mg of QAE /g of sample).

C (mg/g, in QAE) = C1*V/m

where C = Total flavonoid content in mg/g, in QAE (Quarcetin equivalent), C1 = concentration of Quarcetin established from the calibration curve in mg/ml, V = volume of extract in ml, and m = the weight of the plant extract in g.

Standard preparations

Stock solution (1 mg/mL) of quercetin was prepared by dissolving 10 mg of quercetin in 10 mL of methanol and then the standard solution was diluted serially to make various concentrations of 0.5,1,2,3,4,5 and 6 ug /ml) solutions. The total flavonoid content was expressed as quercetin equivalents using the linear equation based on the calibration curve (quarcetin equivalent (mg of QAE /g of sample).

Statistical Data Analysis

The collected data was analyzed using SAS Statistical software and subjected to two way analysis of variance (ANOVA). The critical difference at $P< 0.05$ was estimated and used to find the significant difference. Least significant difference (LSD) test was used to separate the means.

Results and Discussions

Table 2: Effects of main factors (canning and varieties) on color attributes of MAZ-type common beans

Varieties			L*	a*	b*
Maz-23			20.84^{b}	22.81^{a}	20.37^{b}
Maz-153			29.85^{a}	18.58^{b}	22.57^{a}
Maz-200			19.59^{b}	23.09^{a}	20.44^{b}
CV			10.76	9.22	11.43
LSD			1.30	1.02	1.25
Treatments	ST and BT in minutes	Blanching temperature in ^{o}c	L*	a*	b*
1	20	60	19.29^{d}	20.92^{bc}	21.21^{abc}
2	20	75	23.53^{c}	20.71^{bc}	22.62^{ab}
3	20	88	23.73^{bc}	21.43^{b}	22.97^{ab}
4	30	60	24.01^{bc}	19.36^{c}	20.31^{c}
5	30	75	25.94^{ab}	20.29^{bc}	20.85^{bc}
6	30	88	27.21^{a}	19.84^{bc}	22.41^{abc}
7	40	60	25.60^{abc}	20.05^{bc}	21.709^{abc}
8	40	75	25.27^{abc}	20.62^{bc}	20.99^{bc}
9	40	88	26.55^{a}	20.56^{bc}	23.31^{a}
0	Raw		13.16^{e}	31.130^{a}	14.94^{d}
CV			10.76	9.22	11.43
LSD			2.37	1.87	2.28

CV=Coeffient of variation, LSD =Least significant difference, ST= Soaking time, BT= Blanching time, Means within same column followed by the same letters are not significantly different; ($P > 0.05$)

Colour: Color attributes (L* and b*) of maz-type common bean sample was improved after application of canning procedures. Statistically, significant ($P<0.05$) change were observed for all color attributes of maz-type common as shown in Table 2. Accordingly, the highest value of L* and b* were recorded for Maz-153 while the lowest value were observed in maz-23 (Table2). The higher a* value noted in maz-200 common bean types. The degree of color retention in beans during canning process depends on a genotype's genetic makeup (Qureshi and Sadohara, 2019).

Table 3: Effects of main factors (canning and varieties) on Bioactive compounds of MAZ-type common beans

Varieties			Phenolic (mgGAE/g)	Flavonoid (mg CE/g)
Maz-23			0.65[b]	1.71[b]
Maz-153			0.73[a]	1.05[c]
Maz-200			0.55[c]	2.27[a]
CV			8.83	5.35
LSD			0.03	0.05
Treatments	ST and BT in minutes	Blanching temperature in ^{o}c	Phenolic	Flavonoid
1	20	60	0.82[c]	1.12[g]
2	20	75	0.43[f]	1.72[d]
3	20	88	0.51[e]	1.08[g]
4	30	60	0.35[g]	1.44[e]
5	30	75	0.95[b]	1.42[ef]
6	30	88	0.64[d]	2.15[b]
7	40	60	0.34[g]	1.35[f]
8	40	75	0.28[h]	1.39[ef]
9	40	88	0.23[h]	1.85[c]
0	Raw		1.88[a]	3.22[a]
CV			8.83	5.35
LSD			0.05	0.08

Note: Note: CV=Coeffient of variation, LSD =Least significant difference, ST= Soaking time, BT= Blanching time, Means within same column followed by the same letters are not significantly different; ($P > 0.05$)

Canning process and varieties significantly ($P < 0.05$) affect the bioactive components of maz-type common beans. Accordingly, the highest phenolic 0.73 mgGAE/g and flavonoids 2.27 mg CE/g were recorded in maz-153 and maz-200,respectively.Incontrary, the lowest value of phenolic 0.55 mgGAE/g and flavonoids 1.05 mg CE/g were noted for maz -200 and maz-153, respectively. Significant ($P < 0.05$) reduction of Phenolic and flavonoids contents for the maz-type common beans were observed in the present study compared to raw maz-type common bean flour as indicated in Table 8. The reduction of phenolic compounds as a result of canning procedures noted in the present study was in agreement with the research found by Parmar *et al*., (2016) who reported significant reduction of phenolic compounds in canned kidney beans, chickpeas and field pea.

Conclusions

The results revealed that different canning treatments and maz-type common bean lines had significant impact on color attributes and bioactive compounds of the beans sample. Maz-type common bean lines have scored good in color attributes. Color attributes, a* value was decreased where as the L* and b* values were increased in canned beans type. Caning process also brought good retention of bioactive compounds in different maz- type common bean lines.

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