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Research Article

Effect of Variety on Soaking and Cooking Quality of Common Bean

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Abstract: Soaking is an integral part of different preparation methods for pulses. Cooking of legumes reducing phytic acid and tannins. We investigate in this study the cooking quality of beans as affected by varieties. Twenty-seven genotypes of common beans (*Phaseolus vulgaris* L.) with different colors of seed coat (white, yellow, light red, red mottled, cranberry, brown and black) grown in 2018 summer season at El-Dalgamon village, Kafr El-Zayyat, El-Gharbia Governorate, Egypt were selected for this study. Beans soaked in distilled water for 12hr at room temperature. The hydration coefficient was also determined. Then seeds were cooked, and the cooking quality and Phenolic content were determined. The results of this study indicate that there are three categories of seeds depending on seed ability to bind water. These categories also affect the cooking time. results pointed out that the colored beans had high amounts of phenolic content. Also, phenolic content decreased by cooking as compared by dry beans.
Keywords: common beans, soaking, cooking quality.

INTRODUCTION

Common bean (*Phaseolus vulgaris* L., Family: Fabaceae) is consumed worldwide, especially in Latin America and Africa (FAO, 2017). It is a traditional food in the human diet, has low lipid content and is rich in proteins, vitamins, complex carbohydrates and minerals (Costa *et al.*, 2006; Anton *et al.*, 2008; Toledo and Canniatti-Brazaca, 2008; Montoya *et al.*, 2008; Gathu and Njage, 2012).

Beans present great variety in color, size, chemical composition and hardness, depending on the cultivar to which they belong. These differences come from intrinsic factors (genotype, which is partially responsible for the differences between cultivars and varieties) or from extrinsic factors such as storage conditions, type of cultivation soil, agronomic practices and climatic and technological factors (González *et al.*, 2006; Amir *et al.*, 2007; Montoya *et al.*, 2008; Gathu and Njage, 2012; Aghkhani *et al.*, 2012).

Pulses have a rich composition of nutrients (Siddiq & Uebersax,2012 and Hayat et al., 2014). Some of their components exhibit desirable health effects such as a decrease in incidences and multiplicity of cancer as was demonstrated using common beans by Bennink (2002) and reviewed by Luna-Vital *et al.*, (2015). Pulses also contain bioactive compounds, such as phenolic compounds, which exhibit antioxidant activity due to their conjugated systems as was shown for common beans (Chen *et al.*, 2015). They are predominantly concentrated in the seed coat (Nasar-Abbas *et al.*, 2009).

The factors responsible for beans hardening defect could be listed: (1) complexation reactions between pectin-cation-phytate (Njoroge *et al.*, 2014); (2) cell wall lignification (Shiga, 2004); (3) interactions between proteins and starch (Liu *et al.*, 1992); and (4) interactions between tannins and other phenolic compounds with proteins. These factors resulted in increased cooking time, reduced palatability, decrease in nutritional value, and the consumers' acceptability (Nasar-Abbas *et al.*, 2008; Njoroge *et al.*, 2014).

Soaking is a very crucial process that is an integral part of different preparation methods for pulses, such as domestic cooking and industrial canning where it facilitates faster cooking through sensitizing biopolymers to heat treatment (Bellido *et al.*, 2006). During soaking, pulses attain equilibrium moisture content (Kaptso *et al*.,2008), increase in size and weight to a maximum (Abu-Ghannam 1998).

Cooking of legumes improves their nutritional value by reducing antinutrients, such as phytic acid and tannins. Also, it improves protein and starch

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digestibility beside imparts desirable sensory properties to grains (Ranilla *et al.*,2009).

The objective of this study is to examine the cooking quality of beans as affected by varieties.

MATERIALS AND METHODS

Common bean (*Phaseolus vulgaris*) of 26 genotypes from different origin obtained from The Nordic Genetic Resource Center (NordGen), in addition to, the commercial local cultivar Giza 6. Seeds color was obviously different (Table 2). These genotypes were evaluated for horticulture traits on 2016, 2017 and 2018 summer seasons (AlBallat and Al-Araby, 2019 a & b). Suitable bean samples (uniform in size and shape without cracks and very small beans were rejected) were selected by hand picking. Wholesome beans were mixed packed in polyethylene package and stored at 5^{O}C for further analysis.

Soaking Experiment

The beans were soaked at room temperature in distilled water at bean-to- water ratio 1:4 w/v from 30 min. reached to 12 hr. At each 30 min, soaked water was filtered through a sieve and the moist seeds weighed to determined water uptake. Hydration coefficient (HC) was calculated according to (Bhatty,1995).

$$\text{Hydration coefficient (\%)} = \frac{initial\ wt\ (g) + wt\ of\ imbibed\ water\ (g)}{Initial\ wt\ (g)} \times 100$$

Cooking Experiments

Cooking time was determined by taking a known weight of soaked beans in distilled water and cooked in an open pot at 100°C at bean-to-cooking water ratio 1:4 (w/v) for 30 min and 45 min (Plhak *et al.*, 1989; Garcia-Vela and Stanley, 1989). Cooked beans were standing to cool at the room temperature. Cooking quality was determined according to Yeung *et al.*, (2009). The cooked grains were classified to five categories as illustrated in Table (1).

Table-1: Cooking categories as mentioned by Yeung *et al.*, (2009)

Scale	Description
1 – Undercooked	Grain is difficult or not able to smash and cotyledon feels hard
2 – Slightly undercooked	Grain is less difficult to smash, and cotyledon feels slightly hard
3 - Average cooked	Grain is firm but smashes easily and cotyledon feels soft
4 – Slightly overcooked	There is little resistance to smash grain and cotyledon feels mushy
5 – Overcooked	Grain is easily pressed into a mush

Total phenolic content

Total phenolic content of extracts from beans were determined by Foline-ciocalteau reagent according the method described by Jindal and Singh (1975). A standard curve was prepared by catechin. Results were expressed as mg catechin/ g seed.

Statistical analysis

The obtained data were subjected to analysis of variance (Anova) and mean comparison was carried out using LSD test. Statistical analysis was carried out using SAS (2004).

RESULTS

Hydration coefficient:

Hydration of a seed commences upon immersion in water (Mikac *et al.*, 2015). However, there is controversy on the entry point of water in seeds with possible roles for the lens (strophiole) (Kikuchi et al., 2006), raphe (Koizumi *et al.*, 2008) micropyle (Mikac *et al.*, 2015), seed coat (Ma *et al.*, 2004), hilum (Varriano-Marston, & Jackson, 1981), and combinations of these (Naviglio *et al.*, 2013). Beans were divided to categories according to the ability of bean to bind water as follows:

Category A high water absorption beans

This category contains the bean which bind more than 95% of water (w/w). These seeds varied in color from brown to red except for Giza 6 (white colored). Hydration coefficient of beans are illustrated in Fig (1). Data reveal that SLOALYCKE variety had the highest water absorption capacity followed by MORBRORS GRONA. Also, data indicate that there is not significantly difference between Giza 6 and STÅSHULT in ability of water absorption. This may due to the thin husk of seeds which have the permeable activity.

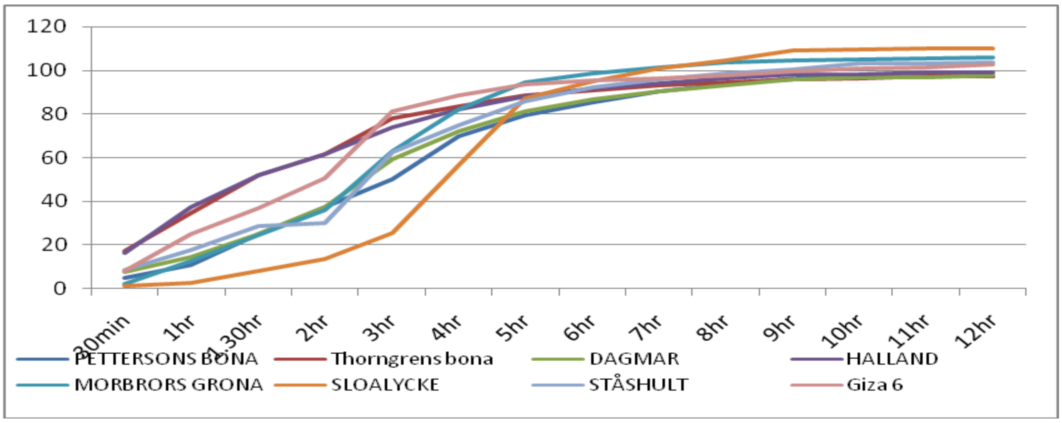
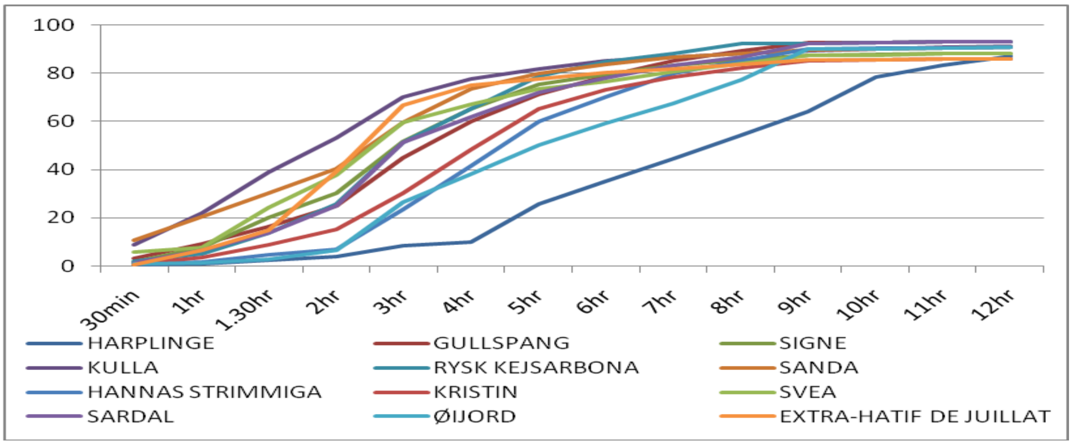


Fig-1: Hydration coefficient of category A beans

Category B moderate water absorption beans

This category beans have the ability of binding water more than 85% and less than 95%.



Figg -2: Hydration coefficient of category B beans. This category beans have the ability of binding water less than 85%.

Category C low water absorption beans

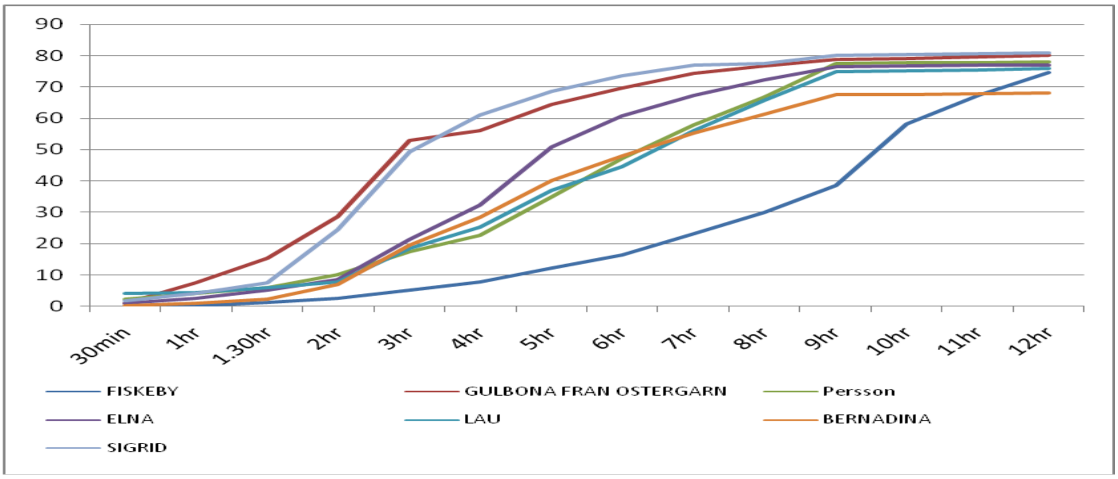


Fig-3: Hydration coefficient of category C beans

Cooking quality

Cooking quality of beans are illustrated in Table (2). Data of Table indicate that the high percentage of hydration coefficient the high quality of cooking (take short time to cooked). On contrary, the seeds with low hydration coefficient especially the varsities of GULBONA FRAN OSTERGARN, Persson, BERNADINA and SIGRID have the lowest cooking quality (need long time to cooked). It could be notice that Giza 6 had the highest cooking quality, since

30 min is more enough to cook it. Also, most of category B had the same trend in cooking time.

Table-2: Cooking quality of studied beans as affect by seeds variety

Name	Seed Color	30 min	45min
PETTERSONS BONA	Black	4	5
Thorngrens bona	Brown	4	5
DAGMAR	Brown	4	5
HALLAND	Brown	4	5
MORBRORS GRONA	Yellow	4	5
SLOALYCKE	Cranberry	4	5
STÅSHULT	Red Mottled	4	5
Giza 6	White	5	-
HARPLINGE	Black	4	5
GULLSPANG	Black	3	4
SIGNE	Brown	2	3
KULLA	Light red	4	5
RYSK KEJSARBONA	Cranberry	3	4
SANDA	Cranberry	4	5
HANNAS STRIMMIGA	Cranberry	3	4
KRISTIN	Cranberry	4	5
SVEA	White	4	5
SARDAL	White	3	4
ØIJORD	White	3	4
EXTRA-HATIF DE JUILLAT	White	4	5
FISKEBY	Black	3	4
GULBONA FRAN OSTERGARN	Brown	2	3
Persson	Red Mottled	2	3
ELNA	Cranberry	3	4
LAU	Red Mottled	3	4
BERNADINA	Yellow	2	3
SIGRID	White	2	3

Total phenolic content of seed as affected by cooking

Total phenolic content (mg/g) are shown in Table 3. Generally, the lower total phenolic content observed in cooked seeds. It is clear that the white beans contained the lowest amounts of total phenolics as compared with dark seeds. The greater losses in phenolics by cooking were observed in dark beans as compared with white beans. These results are in a harmony with those reported by Ranilla *et al.,* 2009 and Rocha-Guzman *et al.,* 2007 & 2013.

Ranilla *et al.* (2009) found the greatest loss in phenolic were found in samples where the cooking water was discarded, which may indicate that great loss is because of cooking. They stated that there is a relation between phenolic and antioxidant activity of seeds and losing of antioxidant may be avoided by consuming the beans with the cooking water. Boateng *et al.,* (2007) and Xu *et al.,* (2007) reported that the protective effect of beans against certain chronic diseases has been associated with the presence of phenolic compounds. However, high levels may become undesirable when they impair digestion and protein absorption, inhibiting the activity of digestive enzymes such as α-amylase and trypsin (Vadivel & Pugalenthi, 2008).

Table (3): Total phenolic content as affected by cooking.

Name	Dry seeds*	Cooked seeds
PETTERSONS BONA	148.74±1.15	109.45±.87
Thorngrens bona	145.33±1.98	103.34±0.98
DAGMAR	144.25±1.63	101.36±0.89
HALLAND	138.23±1.75	99.33±0.76
MORBRORS GRONA	122.32±0.98	95.44±0.73
SLOALYCKE	135.33±1.12	99.42±0.82
STÅSHULT	149.89±2.01	109.75±1.01
Giza 6	33.48±0.55	30.15±0.12
HARPLINGE	152.46±1.88	110.34±1.88
GULLSPANG	150.33±1.66	110.22±1.63
SIGNE	133.14±0.68	92.41±0.79
KULLA	143.56±1.23	105.88±1.37
RYSK KEJSARBONA	123.68±1.35	92.96±0.88
SANDA	119.87±1.77	91.21±0.87
HANNAS STRIMMIGA	135.65±1.23	99.71±0.99
KRISTIN	123.51±0.88	92.24±0.68
SVEA	38.12±0.33	28.45±0.23
SARDAL	39.66±0.28	28.65±0.35
ØIJORD	42.32±0.15	28.15±0.38
EXTRA-HATIF DE JUILLAT	37.23±0.23	25.33±0.33
FISKEBY	152.85±2.23	109.45±1.53
GULBONA FRAN OSTERGARN	133.64±1.74	101.28±0.89
Persson	132.88±1.45	101.15±0.77
ELNA	123.98±1.82	94.66±0.72
LAU	128.55±0.79	99.54±0.43
BERNADINA	118.95±1.02	89.65±0.76
SIGRID	39.87±0.55	29.32±0.63

*Significant different $p<0.05$ in row

CONCLUSION

It could be concluded that seed ability to imbibe water affect time cooking and affected by the structure and thickness of the bean coat. Since water absorption increased, the time for cooking is decrease. Cooking had a great effect in phenolic reduction which may inhibiting the activity of digestive enzymes.

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Conflicts of interest

The authors declare that there are no conflicts of interest related to the publication of this study.

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