

Full Length Research Paper

Pasting characteristics of starches in flours of chickpea (*Cicer arietinum* L.) and faba bean (*Vicia faba* L.) as affected by sorting and dehulling practices

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This research was conducted to investigate the effect of sorting and dehulling postharvest practices on the pasting properties of flours of kabuli (Habru variety) and desi (local) chickpea and faba bean (local) grains. The legume samples were obtained from Hawassa University's Agronomy section and prepared for the experiments. The pasting behavior of the flour samples was observed to be greatly influenced by separate and combined sorting and dehulling treatments. The pasting curve of the kabuli type chickpea was observed to be higher than that of the desi type and faba bean flours. The dehulling process had the highest influence on the pasting curves of the samples. The combined sorting and dehulling treatments improved the pasting characteristics of faba bean and desi chickpea flours to a greater extent, revealing the importance of the treatments for the preparation of these grains as ingredients for commercially processed food products. It was observed that the pasting curves of the treated flour samples were generally higher than the control samples. Sorting and dehulling separately and in combination can be used to improve the functionality of slurries or pastes prepared from chickpea and faba bean flours.

Key words: Pasting characteristics, viscosity, sorting, dehulling, chickpea, faba bean.

INTRODUCTION

Legumes, the dicotyledonous seeds of the *leguminosae* family, occupy an important place in the diets of large proportion of population in developing countries. Legumes are the second major category of food crops consumed in developing countries only after cereals (Köksel et al., 1998; Singh et al., 2004; Du et al., 2014). They contain 24 to 68% carbohydrates where starch is the dominating

type with the range of 22 to 45% (Hoover and Susulski, 1991; Hoover and Zhou, 2003; Sofi et al., 2013). Food legumes contain higher level of protein and can supply an average of 16 to 20% of total protein intake (Reddy et al., 1984; Khatoon and Prakash, 2006).

Legumes are among major staple crops in Ethiopia. Chickpea (*Cicer arietinum* L.) and faba bean (*Vicia faba*

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L.) are widely produced and consumed in the country as staple diets but also grown as cash crops for the farming communities as they are among the high value export commodities in the country (Abera, 2010). They are among the four major food legumes produced in Ethiopia (Beyene, 1988; FAOSTAT, 2008). These major crops are distributed in the lower and upper highlands of the country (Amede et al., 2005; Abera, 2010). The method of production and utilization, however, is not developed and there is high level of postharvest loss. Processing and value addition technologies that would enhance the nutritional and market values of the crops are not well developed and expanded. Processing techniques are important to reduce cooking fuel and long holding time requirements (Joshi et al., 2010); reduce levels of anti-nutritional constituents such as trypsin inhibitors, phytic acid and tannins (Taiwo et al., 1997; Wang et al., 2009; Khandelwal et al., 2010); and the occurrence of hardening phenomena [hard-to-cook (HTC)] on prolonged storage (Joshi et al., 2010). Poor postharvest handling and processing leads to huge losses of quality and quantity of the grains (Magan and Aldred, 2007). There is on the other hand a globally growing interest in processing and applying the legumes as ingredients in processed ready-to-serve food products (Alvarez et al., 2014).

Physicochemical properties and starch functionalities of legumes are known to be influenced by the handling and processing practices like sorting, cleaning and dehulling (Huang et al., 2007; Sreerama et al., 2009; Du et al., 2014). These properties also vary with cultivars and crop types (Singh et al., 2004; Zia-Ul-Haq et al., 2007; Miao et al., 2009; Ma et al., 2011; Emmambux and Taylor, 2013). To the best of the authors' knowledge, there are no published works on the starch pasting characteristics of food legumes grown in Ethiopia particularly pertinent to the influence of sorting and dehulling practices. The current study was carried out to investigate the effect of postharvest practices on the functionalities of the legume flours.

MATERIALS AND METHODS

Sample collection and preparations

The study materials: kabuli type chickpea (habru variety) and desi type chickpea (Wolayita local variety)] as well as faba bean (local) were collected from Hawassa University's Agronomy section and farmer's trial plots in Southern Ethiopia. The samples were subdivided into four lots. One of the lots was randomly selected and kept as control while the others were subjected to sorting, dehulling and a combination of these two postharvest treatments. Sorting was done manually to separate the wholesome grains based on color and size (smaller size, broken and unusual colored pulses were removed), while dehulling was done to remove the upper coat of the pulses using impact de-huller machine (AB, Processing the world's crop, Chelworth Malmesbury Wiltshire SN16 9SG, England). The samples were then separately milled using a hammer mill (Thomas Scientific Mill, Model 4, and Swedesboro, NJ 08085, USA), into flours of 1 mm sieve size; packed in polyethylene bags

and stored in a refrigerator until they were required for the pasting trial.

Pasting property

Pasting properties of the flour were studied using the AR G2 Rheometer (TA Instruments New Castel DE, USA), as per the method described by Chen et al. (2014) with slight modifications. The flour samples were prepared into suspensions (8% w/w, 25 g total weight). Viscosity profiles were recorded in 4 steps, which all together took about 20 min. The first step was allowing the suspension to reach a temperature of 35°C within a period of 1 min. The second step was raising the temperature to 95°C with the rate of 15°C per min. The suspension was held at 95°C for 6 min in the third step. The fourth step was reducing the temperature to 35°C within a period of 7 min. The samples were continuously stirred with a constant shear rate of 16.76 per s. The viscosity profile of the samples subjected to the different postharvest practices were measured and recorded against time and temperature.

RESULTS AND DISCUSSION

Starch pasting characteristics: Control samples

The pasting properties of starches in flours of desi type chickpea (local), faba bean (local) and kabuli type chickpea (Habru variety) are presented in Figures 1 to 4. The control flour samples from the three legumes showed distinctly different pasting characteristics. The starch of Habru variety chickpea showed the highest pick of viscosity and sustained higher pasting curve than the other grains as temperature and time increased. This indicates that the kabuli chickpea flour has faster water absorption and its starch globules rapidly swell to a greater extent. Similar trend was reported for the kabuli type chickpea by earlier studies (Kaur and Singh, 2005; Miao et al., 2009; Sanjeewa et al., 2010). Generally similar trend of pasting characteristics was reported for chickpea by Huang et al. (2007). The pasting curve of faba bean was observed to be lower than that of the chickpea samples. The reason may be that the faba bean starch is slower in its water uptake and swelling performances. Other studies also reported the faba bean pasting to be the lowest compared to that of mung bean and other cereals as well as root crops (Naivikul and D'apponia, 1979; Liuet al., 2006).

Starch pasting characteristics: Treated samples

Sorting

The pasting curves of the three samples subjected to the sorting treatment were generally higher (Figure 2) than that of the control samples (Figure 1). Sorting treatment obviously influenced the pick viscosity of faba bean slurry. The reason may be due to the separation of damaged, immature and discolored kernels from the

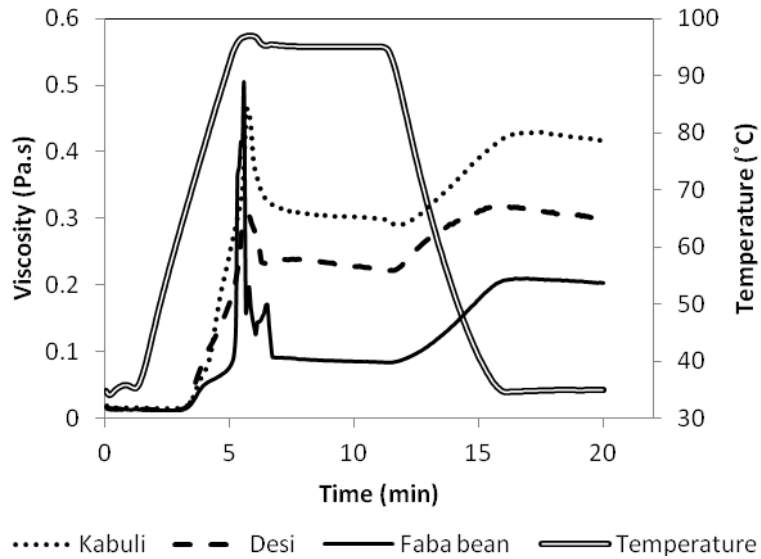


Figure 1. Pasting characteristics of legume flours.

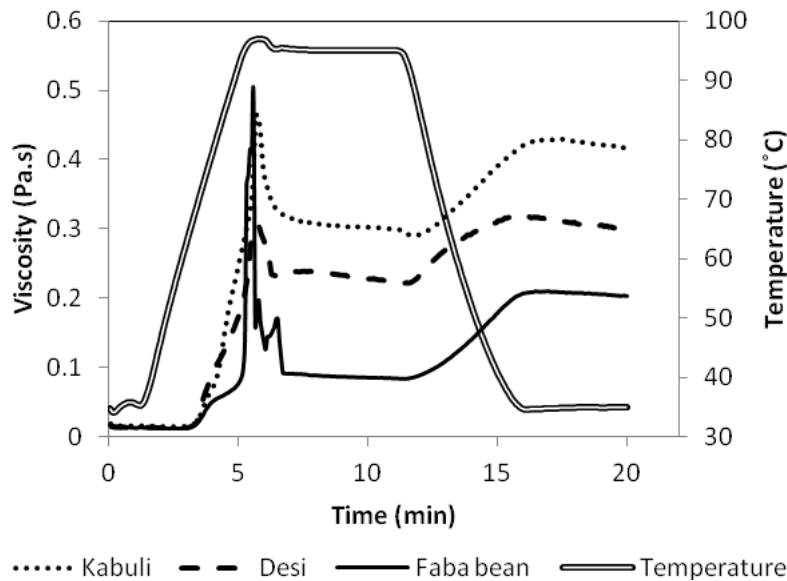


Figure 2. Pasting characteristics of legume flours as affected by sorting treatment.

samples which results in a more sound and wholesome grain with concentrated functional starches on milling.

Dehulling

Dehulling influenced the pasting characteristics of the legumes (Figure 3). The pasting characteristics of kabuli (Habru variety) and faba bean flours increased as a result of dehulling. The pasting curve of the desi chickpea flour

was far below the control and other two dehulled legumes. The reason of increased viscosity of the kabuli chick pea and faba bean flours might be due to the increased starch proportion as compared to the fibrous flours from undehulled samples. Similar trend was reported by earlier studies (Anton et al., 2008; Abiodun and Adepeju, 2011; Akinjayeju and Ajayi, 2011). The reduction in the viscosity of the desi chick pea might be due to slower water absorption and swelling of the starches compared to the other two samples.

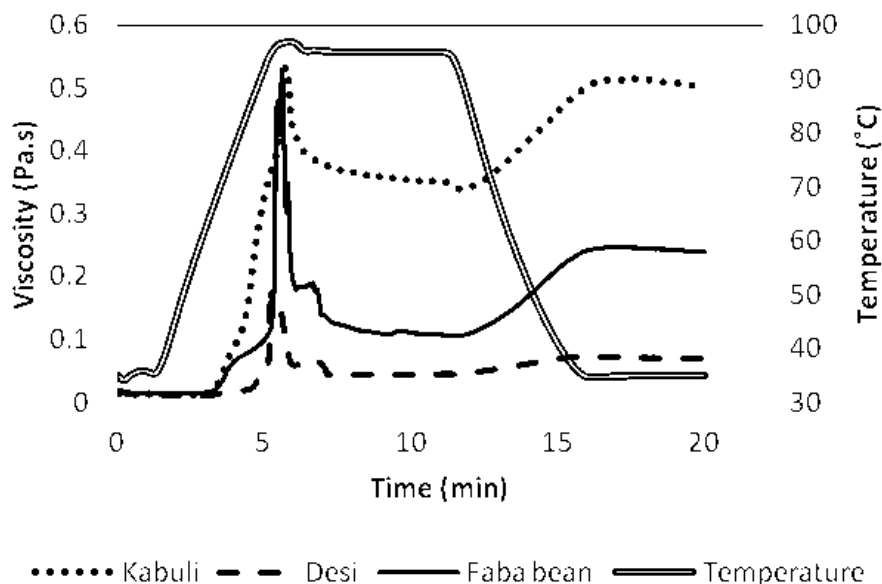


Figure 3. Pasting characteristics of legume flours as affected by dehulling treatment.

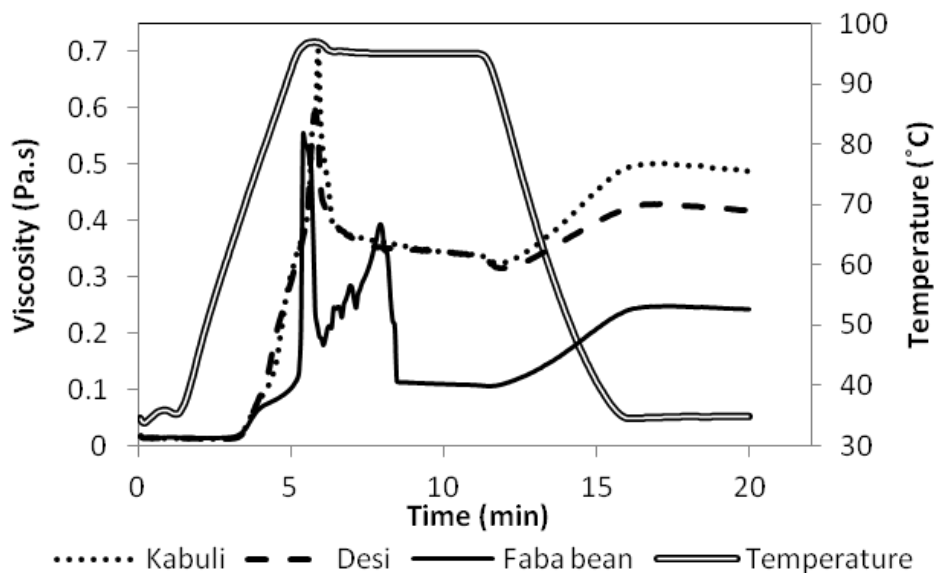


Figure 4. Pasting characteristics of legume flours as affected by sorting and dehulling treatments.

Combined effect of Sorting and dehulling on pasting characteristics of legumes as starches

The combined sorting and dehulling postharvest practices improved the pasting characteristics of the three legumes (Figure 4). The pasting characteristics of all the flours of the three grains were improved by the combined effect of the sorting and dehulling treatments.

The pasting characteristics of the faba bean and desi type chickpea flours were influenced more than the kabuli chickpea flour. The reason for the observed trends might be due to the concentration of starches from whole and sound grain kernels due to the removal of damaged kernels and hulls. The current finding (enhanced pasting behavior) of legume flours, concurred with earlier research reports (Anton et al., 2008; Abiodun and

Adepeju, 2011; Akinjayeju and Ajayi, 2011).

Conclusion

Sorting and dehuling separately and combined improved the viscosity of slurries prepared from flours of chickpea (both kabuli and desitypes) and fab bean. It was observed that the pasting curves of the flours obtained from sorted samples (Figure 2), dehulled samples (Figure 3) and sorted and dehulled samples (Figure 4) were generally higher than that of the control samples (Figure 1). The present study revealed that postharvest practices: sorting and dehuling can be employed in the preparation of food ingredients from legumes to enhance the quality and functionality of processed products.

Conflict of Interests

The authors have not declared any conflict of interests.

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