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## Investigating the Effect of Roasting Time on Some Physicochemical, Technological, Flowability, Antioxidant and Sensory Properties of Roasted Soybean Flours as Cocoa Substitute

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### Abstract

Considering the importance of finding suitable substitute for cocoa powder, the effect of roasting process on physicochemical characteristics (pH,  $a_w$ , WHC, OHC and colour parameters), compositional properties, some physical and thermal features (particle size, bulk & tapped densities, porosity, Hausner ratio, Carr index, repose angle and DSC); antioxidant characteristics and sensory properties of roasted soybean were investigated. The soybean samples roasted at 165 °C for 4, 6, 8, 10 and 12 min, then milled and sieved (No.40). Nutritional elements, Mg, Na, Ca, Zn, Cu and Fe increased during roasting. Repose angle,  $a_w$  and moisture content decreased by increasing roasting time. Hausner ratio and Carr index of raw soybean flour were 33.3 and 1.51 respectively, they decreased to 28.73 and 1.40 after roasting for 12min. Study showed that raw soybean flour had a weak flowability.  $L^*$  as a time-temperature index at roasting process of foods (like coffee and cocoa) decreased by increasing time. Antioxidant activity results suggested that antiradical activity and total phenol content of roasted soybean flours increased by roasting time and a significant correlation between these two items were observed ( $P<0.05$ ). DSC analysis showed that flours had a high thermal resistance. Sensory properties evaluation showed that soybean flour roasted for 8 min, had a comparable total acceptance to cocoa powder.

**Keywords:** Cocoa Substitute, Physical Properties, Roasting, Sensory Properties, Soy Flour

### Introduction

According to World Cocoa Foundation and ICCO annual reports (2014) on world cocoa production and consumption, cocoa market would encounter a shortage by 2020 (ICCO, 2014; WCF, 2014). One of the solution to overcome this issue is to find proper cocoa substitutes. Carob powder is one of these substitutes that is produced by roasting, milling and sieving of the kibbled carob and mainly used in food industry as a substitute or extender for cocoa. Effect of different roasting process on sensory, antioxidant and browning properties

of carob powder was investigated by some researchers (Yousif *et al.*, 2000). Soybean could be another potential case for cocoa substituting, since during roasting process, coffee like flavor can be produced in it. Some physico-chemical, antioxidant and sensory properties of different kinds of soybean have been investigated during roasting process (Lee *et al.*, 2009; 2013; 2015). These products are particularly suitable for the manufacture of caffeine-free and theobromine-free chocolate substitutes (Sahin *et al.*, 2009). Some physicochemical characteristics (pH, aw, WHC, OHC and colour parameters), compositional properties, some physical and thermal features (particle size, bulk & tapped densities, porosity, hausner ratio, ripose angle and DSC); and antioxidant characteristics of soybean were measured during roasting at 165 °C for 4, 6, 8, 10 and 12 min. Results showed that technological properties reduced by increasing roasting time, while roasting significantly raised antioxidant and sensory characteristics ( $P<0.05$ ).

### Material and methods

Soybean (GTX variety) was provided from Toos Soya Pro Co. Sample roasted at 165C for 4, 6, 8, 10 and 12 min in an electrical lab roaster, milled and sieved (No.40). Then stored in tightly sealed glass jars at refrigerators. OHC and WHC were measured trough Yu *et al.* (2007), protocol by some amendments. Chemical features (fat, moisture, protein and ash percentage) were analyzed by AOAC methods (No 925.10, 945.39, 942.05 and 920.87), (AOAC, 2003). PSD measured by Mastersizer micro Malvern. Colour parameters determined by chromameter C4-410 (Osaka, Japan). Flow properties of flours measured by Pharmatester PT-TD200 (Narayana *et al.*, 1984). Total poly phenol content (TPC) was measured by Singleton method (1956), determining total flavonoid content (TFC) and DPPH respectively went thorough Vissotto *et al.* (2010) and Blois (1958) methods. Sensory properties (color, taste, smell and total acceptance) of roasted soybean flours were evaluated by 9 points Hedonic test carried out by 10 panelists (Yousif *et al.*, 2000).

### Result and discussion

Roasted soybean flours' physicochemical ( $a_w$  and pH) and technological (WHC and OHC) properties significantly decreased by increasing time ( $P<0.05$ ). High amounts of OHC in roasted flour introduce it as a food ingredient with great potential for flavor holding in food systems with high demands of oil bonding capacity (Turan *et al.*, 2015).  $L^*$  and  $a^*$  color parameters of roasted soy flours at 8, 10 and 12 min were equal to those for cocoa powder (Zyzelewicz *et al.*, 2014). Chemical analysis results showed that moisture and protein content of flours reduced by time, while ash raised during roasting as well as fat content. Oboh *et al.* (2010), suggested raising of fat content during roasting is due to thermal breakdown of some bonds in matrix of samples that causes to release fat. Nutritional elements, especially Mg, Ca and Fe increased during roasting. All physical parameters reduced during roasting process. Considering repose angle of flours, their flow properties were "weak", but with increasing time of roasting, flowability of roasted flours improved based on Hausner ratio and Carr index reduction (Shah *et al.*, 2008). Antioxidant activity result suggested that antiradical activity and total phenol content of roasted soybean flours increased by roasting time and a significant correlation between these two items were observed ( $P<0.05$ ). DSC analysis showed that powders had a high thermal resistant. From sensory point of view, overall acceptability of roasted soy flour at 8 min gained the highest score.

### Conclusion

Roasted soybean flour have potential nutritional, antioxidant and technological properties in order to use as an ingredient in different food products. Since during roasting process all sensory characteristics of samples raised by time, and they gained similar scores to cocoa as

witness, so roasted soybean flours could be introduced as a cocoa extender and applied in bakery products' formulations and chocolate formulations in order to manufacture of caffeine-free and theobromine-free chocolate substitutes.

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