World Academy of Science, Engineering and Technology
International Journal of Agricultural and Biosystems Engineering
Vol:9, No:07, 2015

Changes of Chemical Composition and Physicochemical Properties of Banana during Ethylene-Induced Ripening

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Abstract : Banana is produced in large quantities in tropical and subtropical areas. Banana is one of the important fruits which constitute a valuable source of energy, vitamins and minerals. The ripening and maturity standards of banana vary from country to country depending on the expected shelf life of market. The compositions of bananas change dramatically during ethylene-induced ripening that are categorized as nutritive values and commercial utilization. Nevertheless, there is few study reporting the changes of physicochemical properties of banana starch during ethylene-induced ripening of green banana. The objectives of this study were to investigate the changes of chemical composition and enzyme activity of banana and physicochemical properties of banana starch during ethylene-induced ripening. Green bananas were harvested and ripened by ethylene gas at low temperature (15℃) for seven stages. At each stage, banana was sliced and freeze-dried for banana flour preparation. The changes of total starch, resistant starch, chemical compositions, physicochemical properties, activity of amylase, polyphenolic oxidase (PPO) and phenylalanine ammonia lyase (PAL) of banana were analyzed each stage during ripening. The banana starch was isolated and analyzed for gelatinization properties, pasting properties and microscopic appearance each stage of ripening. The results indicated that the highest total starch and resistant starch content of green banana were 76.2% and 34.6%, respectively at the harvest stage. Both total starch and resistant starch content were significantly declined to 25.3% and 8.8%, respectively at the seventh stage. Soluble sugars content of banana increased from 1.21% at harvest stage to 37.72% at seventh stage during ethylene-induced ripening. Swelling power of banana flour decreased with the progress of ripening stage, but solubility increased. These results strongly related with the decreases of starch content of banana flour during ethylene-induced ripening. Both water insoluble and alcohol insoluble solids of banana flour decreased with the progress of ripening stage. Both activity of PPO and PAL increased, but the total free phenolics content decreased, with the increases of ripening stages. As ripening stage extended, the gelatinization enthalpy of banana starch significantly decreased from 15.31 J/g at the harvest stage to 10.55 J/g at the seventh stage. The peak viscosity and setback increased with the progress of ripening stages in the pasting properties of banana starch. The highest final viscosity, 5701 RVU, of banana starch slurry was found at the seventh stage. The scanning electron micrograph of banana starch showed the shapes of banana starch appeared to be round and elongated forms, ranging in 10-50 μm at the harvest stage. As the banana closed to ripe status, some parallel striations were observed on the surface of banana starch granular which could be caused by enzyme reaction during ripening. These results inferred that the highest resistant starch was found in the green banana at the harvest stage could be considered as a potential application of healthy foods. The changes of chemical composition and physicochemical properties of banana could be caused by the hydrolysis of enzymes during the ethylene-induced ripening treatment.

Keywords : ethylene-induced ripening, banana starch, resistant starch, soluble sugars, physicochemical properties, gelatinization enthalpy, pasting characteristics, microscopic appearance
Conference Title : ICFAPE 2015 : International Conference on Food and Agricultural Process Engineering
Conference Location : Stockholm, Sweden
Conference Dates : July 13-14, 2015