



Study of effect of blade edge on sucrose extraction of sugar beet and quality of raw juice

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Introduction: Conventional technology of sugar production from sugar beet roots consists of the next subsequent steps: sugar beet slicing, thermal denaturation of the sliced beet roots followed by diffusion in hot water at 70–75 °C, purification of extracted juice by lime, concentration of purified juice and crystallization. The diffusion process is one of the most important steps that effect on product yield. The quality of cossettes is too important that increase extraction yield. Therefore the main function of the beet-slicing operation is to improve the diffusion operation. The most important factors in producing quality cossettes are the type of knives. Most knives have a V shape that cause increase of the surface area of the beets. At slicing operation, Amount of the sucrose of beet extract directly. Considering the blade edge causes the rupture of beet cell so it effects on quality of juice and yield of extraction. Also the different blades edge causes different surface areas that effect on osmotic operation. In this work, the effect of two kinds of blades (serrate and flat edge) is studied on extraction process and the juice quality.

Material and method: Fresh sugar beets (*Beta vulgaris*) were obtained from Ferdowsi university farm and storage at 5°C. For each test run, 300gr of cossette 4mm thickness and 8cm in length were cut by cutting device with ability of blade change. The sucrose content of cossettes was measured in ICUMSA method. These tests were organized as follows 4 steps. The first step was washing. Considering amount of sucrose of sugar beet extract directly at slicing operation, the decrease of sucrose content of cossettes and the sucrose of washing juice should be measured. For this stage, 120gr of cossettes were washed with 320gr of distilled water. After washing the cossettes, the sucrose content of cossettes was measured again and the decrease of sucrose content of cossettes was calculated and sucrose of washing juice was measured. For the thermal-pretreatment step, 130gr of sugar beet cossettes were treated with 260gr of distilled water 70°C at 7min and the sucrose of thermal-pretreatment juice was measured. In the diffusion step, 130gr of these cossettes were immersed in 260gr of distilled water 73°C. The solute concentration (Brix, g solubles 100 g₁ juice) was measured by digital refractometre (PR-101, Atago, 50 Kyo, Japan) every 5 to 10 min up to equilibrium conditions. The final step was pulp pressing. The pulps were compressed by laboratory press (2 bar) at 15min. following by the pressed pulp was weight then the sucrose content of them was measured. In the following, purity and nonsucrose of juice were determined for washing, thermal-pretreatment and diffusion steps. These parameters were measure in ICUMSA unit which is based on polarimeter method. Also extraction yield of diffusion, mass of extraction sucrose and extraction sucrose at diffusion, pressed pulp yield, extraction degree and energy were calculated. The data were analyzed in 2-sample t-test at minitab17 and the graphs were drew in excel.

Results and discussion The results showed that the edge of the baled had significant effect on the juice purity (washing and thermal-pretreatment steps), non-sucrose content and sucrose of juice, extracted sucrose at cutting operation, extracted sucrose at diffusion, degree of extraction, yield of pulp, time and energy ($P < 0.05$). The most juice purity was obtained from flat blade with 78.33%, 84.86% and 85.52% at washing, pretreatment and diffusion steps respectively. Also the least of non-sucrose content was obtained from this blade with 0.1%, 0.55% and 0.51% at washing, pretreatment and diffusion steps respectively. The serrate blade increase the tearing (rupturing) of the beet cells at slicing operation. Torn cells allow more impurities (nonsugars) to be diffused into the surrounding juice, causing an increase in nonsugars and, consequently, a reduction in juice

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purity. For the serrated blade, The most extracted sucrose at cutting operation and diffusion step, mass of sucrose of diffusion juice and degree of extraction were obtained 14.5%, 94.4%, 7.22 gr and 0.19 respectively that compare to another blade is more. The edge of serrate blade increases the surface aria of cossettes compare to use of flat blade. The surface area is one of the most important parameter to improve osmotic operation. The more contact area between the beet cells and the water in the diffuser cause the more movement of sugar from the cells to the diffusion juice. Therefore the use of the serrate blade improves the osmotic operation and enhances the extracted sucrose. The least of pulp yield, extraction time and energy were obtained 27.97%, 40 min and 1.7 Kw/h respectively for this blade. The increase of sucrose extraction reduces the pulp yield. As regards osmotic operation improve whit the increase of surface area cossettes, therefor the sucrose extract at lees time and the total energy decrease. Regarding to the results, both of blades improve some of the extraction parameters.

Key words: Sucrose Extraction, Cossette, Sugar Beet, Blade