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Maximizing utilization of onion green residues

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ABSTRACT

The present study was carried out in Faculty of Agricultural Engineering, Al- Azhar University, Nasr City, Cairo, Egypt during 2015 – 2016 season to onion cultivated (Gize 20 verity) after cutting leaves for slices (length slice 3 cm). The aim of onion green residues mince is to utilization of residues and producing juicing which is considered as the most effective preparation for securing all health benefits. To achieve this aim, a house mixer with a 0. 800 kW motor was used. Factors studied were three screen hole diameters (3, 4.5 and 6 mm), three moisture content (85, 75 and 65 %) and tow rotation knife speed (2000, 1500 r.p.m) at feeding mass 150 g. The performance of the mince was evaluated according to the actual mince capacity, power and energy requirements and sample content from Protein and Fat. The results showed that the highest productivity was 31.5 kg / h and minimum specific energy 0.0047 kW. h / kg obtained at 6 mm screen hole diameter, 85 % moisture content and rotation knife speed 2000 r.p.m. While the requirement power highest 0.181 kW at 3 mm screen hole diameter, 65 % moisture content and rotation knife speed 2000 r.p.m, and the analysis sample content from Protein and Fat with three samples moisture content of 85, 75 and 65 % (10.85, 9.45 and 9.97 %) and (1.75, 0.82 and 6.1 %) respectively.

1. Introduction

Onion is considered as the most important and widely cultivated vegetable in Egypt, due to its nutrition value. The crop is planted for local consumption or exporting. The total cultivated area of onion crop is about 280.611 fed., producing about 2.5 million tons of onion crop (Ministry of Agriculture and Land Reclamation 2012). Onion bulbs are always harvested at complete mature stage with green topping leaves and high moisture content. One of the major problems facing exportation of Egyptian onion is the lower storability characteristics when shipping to the European countries that exposing the bulbs to decay and hence facing rejection from the exporter (Abd-Elrahman et al., 2009). Grahame (2005) and Marita (2006) showed that curing bulbs is the process by which the outer leaf sheaths and neck tissues of the bulb then dried.

Pandey et al. (1993) stated that total loss in weight of bulbs during a storage period increased by decreasing the maturity stages to 20 % tops down and lowest of onion bulbs was always associated with highest value of average percentage of total loss in onion weight 17.74 %. Hashish et al. (1994) studied some factors affecting the performance of chopping, crushing, and grinding equipment for field raw material, they concluded that the optimum speed was found as 9.4 m/s for the three tested raw materials and the highest production rate and efficiency were obtained at low levels of moisture content of raw materials. Yousf (2005) reported that the power requirements of the grinding operation increased with increasing feed rates, while it decreased with increasing screen opening size. The best results of power consumption were obtained at 29.5 m/s hammer speed, 550 kg/h feeding rate and screen opening sizes of 6.

The main objective of this research is to test and performance of a small house mixer during cutting and crushing (juicing) onion crop residues. Also, to optimize some operating parameters affecting the performance of the used house mixer such as the moisture

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content of crop residues, screen hole diameters and rotation mixer speed.

2. Materials and methods

The experiments were carried out at Faculty of Agricultural Engineering Al-Azhar University, Nasr City during 2015 – 2016 season for house mixer.

Onion leaves: onion cultivars (Gize 20 verity) were selected to apply this study after cutting leaves for slices (length slice 3 cm) with three moisture content (85,75 and 65 %).

House mixer: the used mixer juicing in this study is shown in Fig 1. The specifications of the mixer are presented in Table 1. The mixer is directly driven by an electric motor, blade (stainless steel). During this study the following parameters of the juicing were tested: three screen hole diameters (3, 4.5 and 6 mm), three moisture content (85, 75 and 65 %) and tow rotation blades speed (2000 and 1500 r.p.m) at feeding mass 150 g.

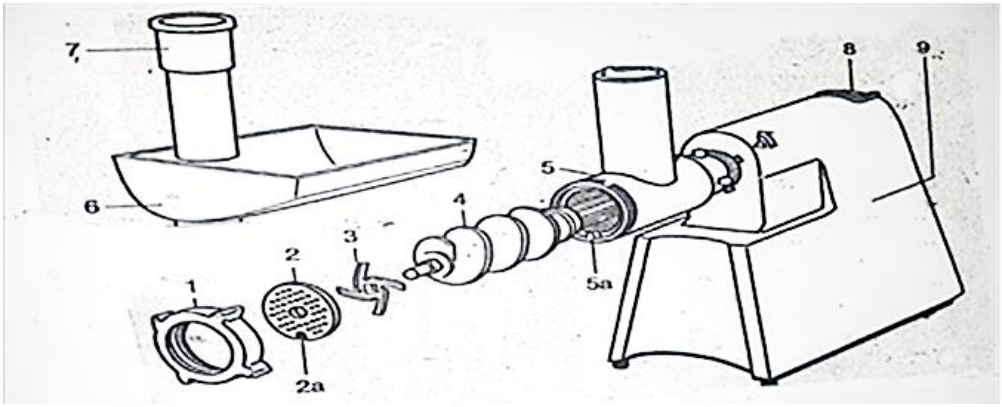

Fig. 1. The used house mixer.

① Cap. ② Disc. ②a Notch in the disc. ③ Blade (stainless steel). ④ Worm. ⑤ Grinder head with filling shaft. ⑥ Feeder tray. ⑦ Pusher. ⑧ on/off switch. ⑨ Motor unit.

Table 1
Specifications of house mixer.

Specifications	
Manufacture county	Czech Republic
Type	Mixer perawin
Model	G 1500
Rotor diameter	15 cm
Rotation mixer speed	2000 r.p.m
Number of blades	4 blades
Blades length	20 mm
Power source	Single phase electric motor
Motor	0.800kW

2.1. Measurements

2.1.1. Moisture content of onion residues

The moisture content (MC) was measured according to ASAE standard (1994) by taking a sample of onion residues. The average moisture content was determined in (d.b) basis by using oven method at 377°K (105° C) for 24 hours and calculated by the following equation:

$$MC\ \% = \frac{M_w - M_d}{M_d} \quad \text{... [1]}$$

where MC: Moisture content of onion residues (%), M_w: Sample mass before drying (g), and M_d: Mass of dried sample (g).

2.1.2. Productivity

Juicing time of 150 g of onion green leaves was measured by means of a stopwatch to determine the house mixer productivity in kg / h.

$$\text{Productivity} = \frac{\text{Mass of juicing onion green leaves (kg)}}{\text{Time of juicing (h)}} \quad \text{... [2]}$$

2.1.3. Juicing power requirements

A digital AVO meter was used for measuring the current Amber before and during experiments the total consumed electric power under house mixer working load (kW) was calculated according to Lockwood and Denstan (1971) by the following equation.

$$\text{Power (kW)} = \frac{I.V.\eta.\cos\alpha}{1000} \quad \text{... [3]}$$

where I: Current strength in Amperes, V: Voltage strength (equal to 220 V), Cos α: Power factor (equal to o.85) and Π: Mechanical efficiency assumed to be (90 %).

2.1.4. Specific energy requirement

The specific energy requirement (kW. h/kg) was calculated by using the following equation:

$$\text{Specific energy requirement} = \frac{\text{Power (kW)}}{\text{Productivity (kg/h)}} \quad \text{... [4]}$$

2.1.5. Sample content from Protein and Fat

The analysis sample content from Protein and Fat with three samples moisture content of 85, 75 and 65 % used Appliance (NIRA-DA-1650 FOSS).

3. Results and discussions

3.1. Effect of screen hole diameters on juicing productivity

Fig. 2 illustrated the relationship between the screen hole diameters "Sd" (mm) and juicing productivity "CPr" (kg / h) at different moisture content and rotation knife speed.

The obtained data showed that the house mixer productivity increased with the increase of both screen hole diameters and moisture content and rotor mixer speed. The maximum value of juicing productivity was 31.5 kg / h at screen hole diameter of 6 mm, 85 % moisture content and 2000 r.p.m rotation knife speed. While the minimum value of juicing productivity was 12 kg / h at screen hole diameter of 3 mm, 65 % moisture content and 1500 r.p.m rotation knife speed

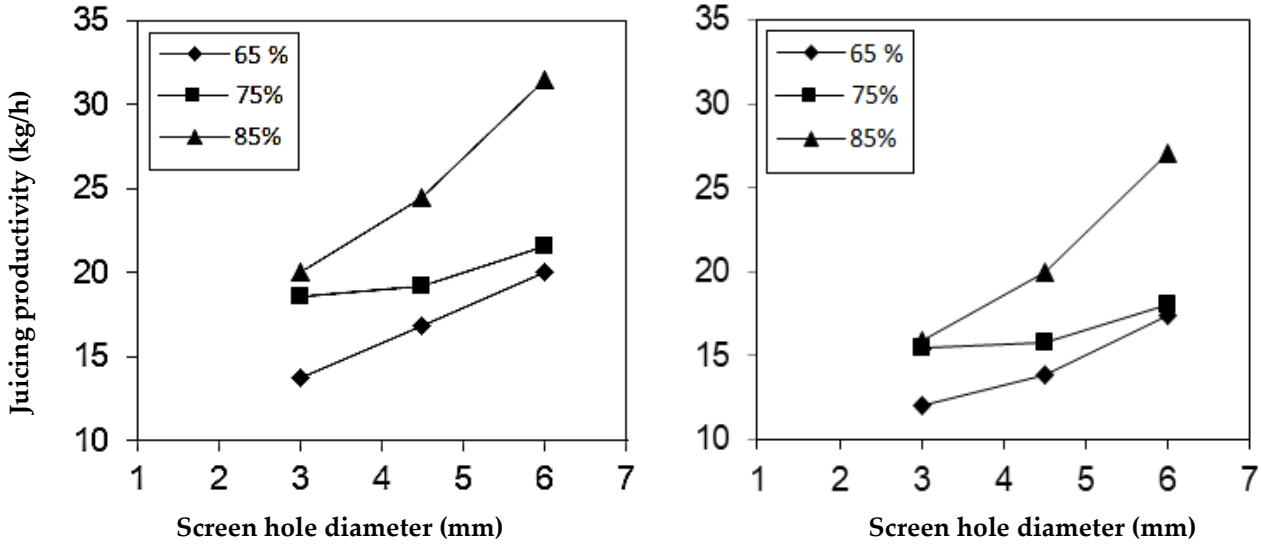

Fig. 2. Effect of screen hole diameters on juicing productivity at different moisture contents and rotation knife speed.

3.2. Effect of screen hole diameters on power requirement

Fig. 3 illustrated the relationship between the screen hole diameters "Sd" (mm) and power requirement "Pr" (kW) at different moisture content and rotation knife speed.

The obtained data showed that the house mixer power requirement increased with the decrease of both screen hole diameters and moisture content and increase rotor mixer speed. The maximum value of power requirement was o.181 kW at screen hole diameter of 3 mm, 65 % moisture content and 2000 r.p.m rotation knife speed: While the minimum value of power requirement was 0.131 kW at screen hole diameter of 6 mm, 85 % moisture content and 1500 r.p.m rotation knife speed.

3.3. Effect of screen hole diameters on specific energy requirement

Fig. 4 illustrated the relationship between the screen hole diameters "Sd" (mm) and specific energy requirement "Er" (kW. h / kg) at different moisture content and rotation knife speed. The obtained data showed that the house mixer specific energy requirement decreased with the increase of both screen hole diameters, increase moisture content and increase rotation knife speed.

The minimum value of specific energy requirement was 0.0047 kW .h / kg at screen hole diameter of 6 mm, 85 % moisture content and 2000 r.p.m rotation knife speed. While the maximum value of specific energy requirement was 0.012 kW. h/ kg at screen hole diameter of 3 mm, 65 % moisture content and 1500 r.p.m rotation knife speed.

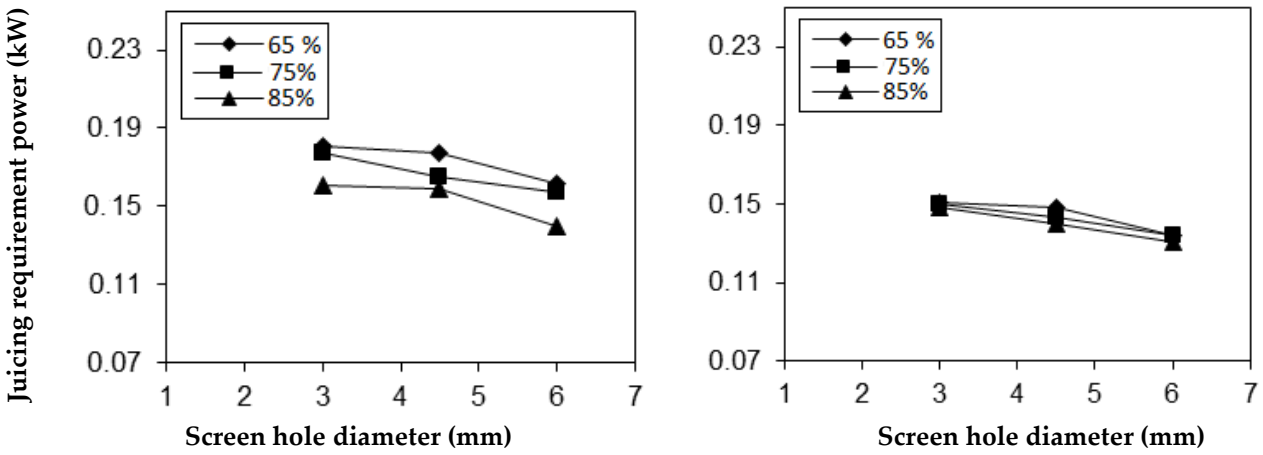

Fig. 3. Effect of screen hole diameter, moisture content and rotation knife speed on Juicing requirement power.

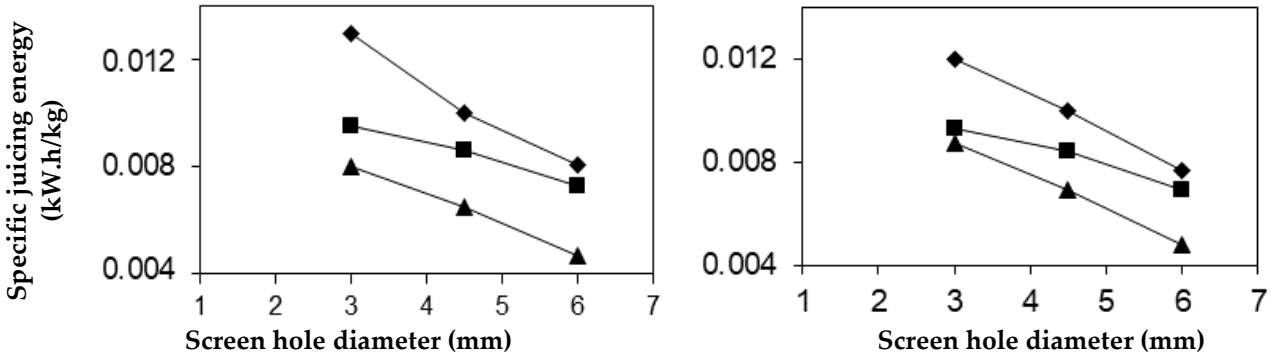

Fig. 4. Effect of screen hole diameter moister, moisture content and rotation knife speed on specific juicing energy.

3.4. Sample content from Protein and Fat

The obtained sample content by chemical analysis. Ratio of Protein, Fat used three sample at moisture content (85, 75 and 65 %) was (10.85 and 1.75 %), (9.97 and 6.19 %) and (9.45 and 0.82%) respectively.

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تعظيم الاستفادة من البقايا الخضراء للبصل

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الملخص العربي

يعتبر البصل من محاصيل الخضر الرئيسية في مصر لما له من أهمية تصديرية، وكذلك استخدامه في كثير من الصناعات الغذائية حيث تبلغ المساحة المزروعة حوالي ٢٨٠٦١١ ألف فدان سنوياً ينتج ما يزيد عن ٢,٥ مليون طن (إحصائية وزارة الزراعة

٢٠١٨) ينتج عنها ٣٠ % مخلفات عند الحصاد. تم إجراء هذا البحث خلال موسم ٢٠١٦ م في كلية الهندسة الزراعية، جامعة الأزهر، القاهرة، مصر.

ويهدف البحث إلى الاستفادة من أوراق البصل عند الحصاد عن طريق فرمها للاستفادة المنزلية حيث تم الفرم باستخدام خلاط منزلي قدرته ٠,٨٠٠ كيلووات. وللوصول إلي هذا الهدف تم اختيار ثلاث فتحات لغربال الفرم (٣ , ٤,٥ , ٦ مم) و ثلاث نسب رطوبة للأوراق (٦٥ , ٧٥ , ٨٥ %) وسرعتان للخلاط (٢٠٠٠ , ١٥٠٠ لفة / د) مع استخدام عينة قدرها ١٥٠ جم مع كل التجارب يتم تقطيعها إلي شرائح طولها ٣ سم والبصل المستخدم (جيزة ٢٠). وتم تقييم أداء الخلاط من خلال إنتاجية الخلاط والطاقة النوعية المطلوبة للفرم والنسبة المئوية لمحتوي العينة من البروتين والدهون عند محتويات الرطوبة المختلفة.

وكانت أهم النتائج:

- كانت أعلي إنتاجية للخلاط ٣١,٥ كجم /س عند استخدام فتحة غربال ٦ مم ونسبة رطوبة ٨٥ % وسرعة ٣٠٠٠ لفة / د.
- كانت أعلي قدرة مطلوبة للفرم ٠,١٨١ كيلووات عند استخدام فتحة غربال ٣ مم ونسبة رطوبة ٦٥ % وسرعة ٣٠٠٠ لفة /د.
- كانت أقل طاعة نوعية مطلوبة للخلاط ٠,٠٠٤٧ كيلووات. س / كجم عند استخدام فتحة غربال ٦ مم ونسبة رطوبة ٨٥ % وسرعة ٣٠٠٠ لفة / د.
- وقد أظهرت نتائج التحليل الكيميائي أن نسبة البروتين والدهون عند محتوي رطوبي (٦٥ و ٧٥ و ٨٥ %) كالآتي ١٠,٨٥ و ٩,٤٥ و ٩,٩٧ %. وكانت نسبة الدهون ١,٧٥ و ٠,٨٢ و ٦,١ %.