Journal of Nuts 6(1):17-25, 2015
ISSN: 2383 - 319x

Evaluation of a Walnut Huller

*G.R. Chegini, A.R. Makarichian**

Department of Agrotechnology, University of Tehran, College of Abouraihan, Tehran, Iran

Received: 1 April 2015 Accepted: 11 June 2015

Abstract

Walnut is one of the high yielding crops in horticultural production, and establishment of walnut orchards is growing. Yet despite Iran's being the second largest producer of walnuts in the world, this country does not play a significant role in walnut export. This gap is most affected by the need to mechanize the harvesting process. This case is more understandable when can construct a new device with greater efficiency in comparison of the existing mechanical systems. In this article, a walnut huller built on the Abouraihan campus of the University of Tehran is evaluated, with Rotational speed, time and brush distance being optimized to make the best quality of hulling process. The results indicate that increasing the rotational speed, increases the amount of walnuts hulled but that the percentage of damaged nuts also increases. If, at a constant rotational speed, the distance between abrasive brushes is reduced, the amounts of nuts hulled and damaged are raised but the degree of hulling is greater than degree of injury. Also, if the distance between abrasive brushes and the rotational speed are decreased, the peeling rate is increased while the damage rate is decreased.

Keywords: Evaluation, Green husk, Huller, Walnuts.

Introduction

Post-harvest processing of agricultural products, in addition to reducing crop losses and expenses related to transportation, can increase product quality, thus adding value to crops and increasing their export. In the case of walnuts, quickly removing the green husk and drying are important post-harvest processing steps. The presence of tannins in the husks of walnuts, which are readily formed on exposure to air, causes shell blackening and hastens the change in kernel color from white to yellow or light brown. Harvested walnuts have a relatively high (30%) moisture content while a moisture content of 8% is needed for storage (Khir *et al.*, 2011; Rajabipour *et al.*, 2010). Obviously, traditional methods for hulling walnuts are not sufficient to meet the enormous volume walnut production.

In order to achieve a proper understanding of the hulling process and also to design an efficient walnut huller, an accurate study of the walnut and its green husk is required (Xu *et al.*, 2012). Therefore, the use of machines that are suitable to a variety of Persian walnut cultivars would be desirable. Walnut has a variety of uses in the food, industrial, pharmaceutical and cosmetics fields (Iso *et al.*, 2002; Çağlarırmak, 2003; Ozkan and Koyuncu, 2005; Colarič *et al.*, 2006; Ozcan, 2009; Bakkalbaşı *et al.*, 2012). Valuable studies have been performed in the field of food science and have demonstrated the positive effects of walnuts in human health. For example, the walnut has positive effects in lowering cholesterol (it is necessary to mechanize and increase the efficiency of the harvesting and post

[*]**Corresponding author:** E-mail**:** a.makarichian@ut.ac.ir

harvesting processes of walnuts. In order to enhance the performance an efficiency of the existing devices, it is necessary to evaluate the performance of devices that are made beforehand.

Materials and Methods

The walnut huller machine evaluated here was built on the Abouraihan campus of the University of Tehran (Chegini and Makarichian, 2014). To evaluate this device, the rotational speeds of abrasive brushes and the distances between them and the grooved cylinder were selected so as to maximize the percentage of nuts hulled and to minimize the degree of damage. In order to achieve this goal, the rotational speeds were 263, 368 and 473 rpm and also the distance between abrasive brushes were chosen 12 and 16 mm. time of tests are divided to three groups so 30, 60 and 12 seconds. Six combinations of speed and distance were evaluated, each test was performed in replicates of three and the percentages of whole peeled (hulled) walnuts, unpeeled walnuts and damaged walnuts were found. The quantity of walnuts in each tests are different and therefor 25, 50 and 75 walnuts were used in different combinations. The walnuts used were the Chandler variety and were obtained from the Tuyserkan Research Institution. Because the performance intensities were dissimilar, different durations of time were used in each test.

Results

Results of quality evaluation and evaluation of performance capacity

The effect of a rotational speed of 473 rpm and a distance of 12 mm between abrasive brushes and grooved cylinder on the quality of peeling at three times (10, 20 and 30 seconds), each of which test was replicated three times (Fig. 1).

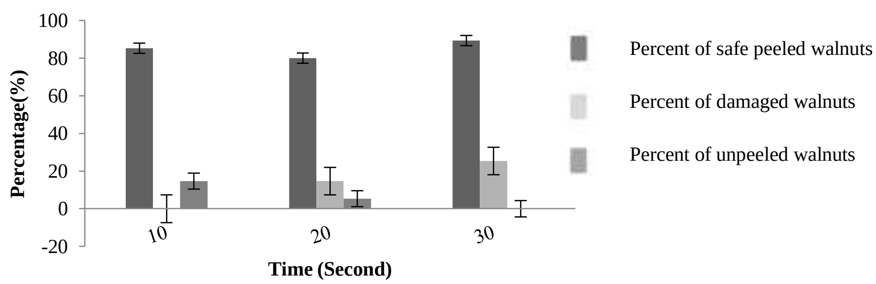

Fig. 1. Effect of a speed of 473 rpm and a distance of 12 mm on shelling quality

In order to realize the effect of a rotational speed of 473 rpm and a distance 16 mm between abrasive brushes and grooved cylinder on quality of peeling the tests were performed in three duriations (10, 20 and 30 seconds) and each of which test was was replicated three times (Fig. 2).

.

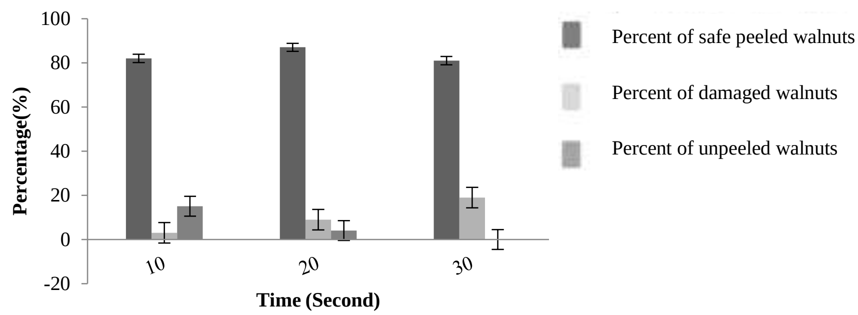

Fig. 2. Effect of a rotational speed of 473 rpm and a distance of 16 mm on shelling quality.

To survey the effect of combination of a distance of 12 mm rotational speed of 368 rpm a on the quality of peeling in six duriations (10, 20, 30, 40, 50 and 60 seconds), each of which test was replicated three times (Fig. 3).

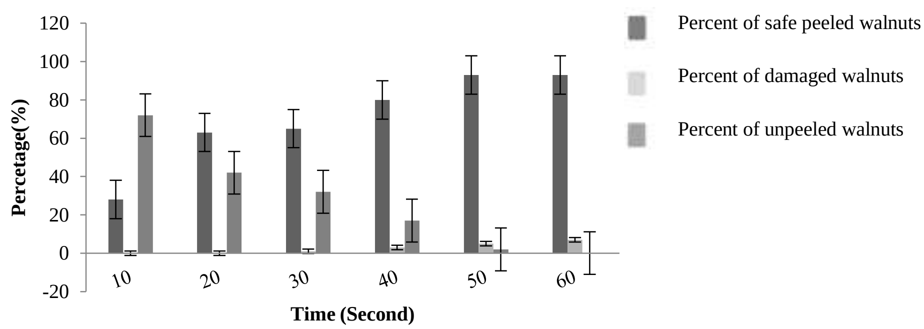

Fig.3. Effect of 368 rpm rotational speed and 12 mm distance on shelling quality

And also at six duriations (10, 20, 30, 40, 50 and 60 seconds), tests were replicated three times under effect of a rotational speed of 368 rpm and a distance of 16 mm on the quality of peeling (Fig. 4).

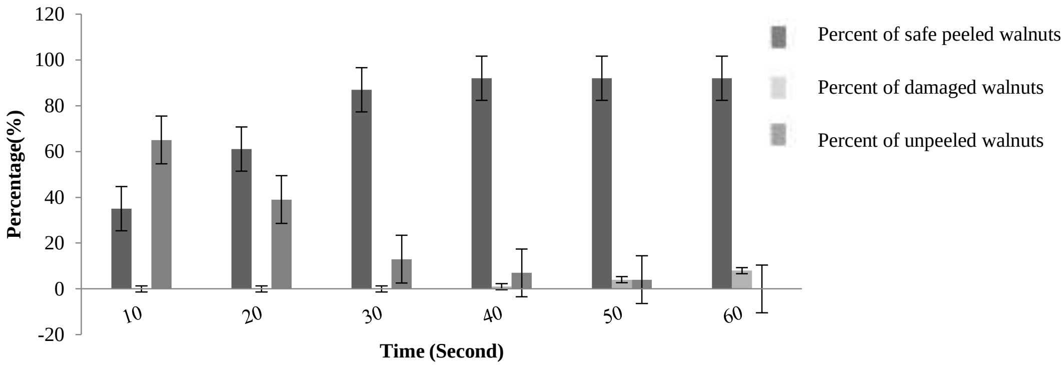

Fig. 4. Effect of arotational speed of 368 rpm and a distance of 16 mm on shelling quality

in order to evaluate the effect of a rotational speed of 263 rpm and a distance of 12 mm on quality of peeling, the tests were done at nine durations (10, 20, 30, 40, 50, 60, 80, 100 and 120 seconds) and three replications (Fig. 5). Also, Fig.6, shows the effect of a rotational speed of 263 rpm and a distance of 16 mm between abrasive brushes and grooved cylinder on the quality of peeling at nine duriations (10, 20, 30, 40, 50, 60, 80, 100 and 120 seconds) and with 3 replications.

.

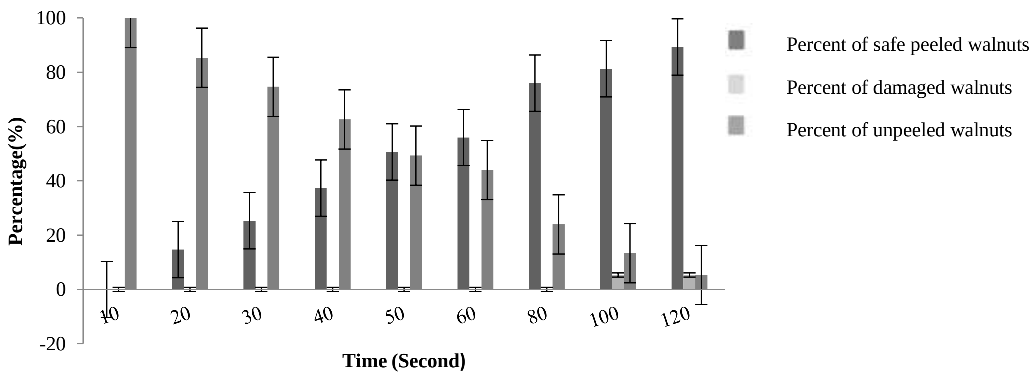

Fig. 5. Effect of a rotational speed of 263 rpm and a distance of 12 mm on shelling quality.

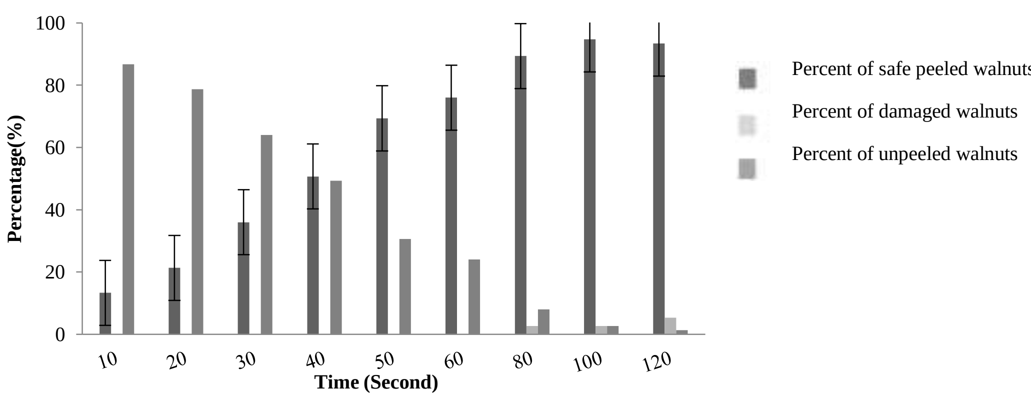

Fig. 6. Effect of a rotational speed of 263 rpm and a distance of 16 mm on shelling quality.

It worth mentioning that Fig. 7 shows the effect of the rotational speed of the abrasive brushes on peeling quality, assuming a constant distance of 12 mm between the abrasive brushes and the grooved cylinder.

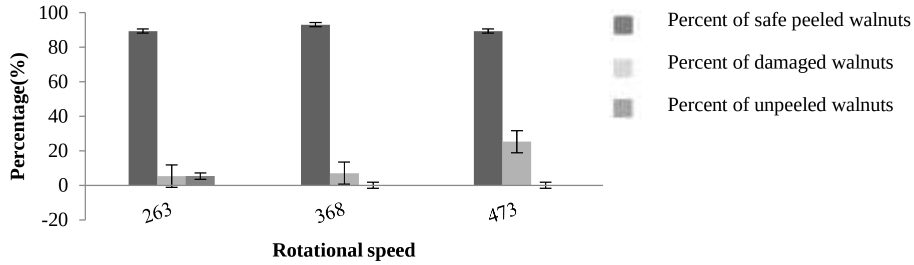

Fig. 7. Effect of different rotational speeds on shelling quality at a distance of 12 mm.

As seen in figure 8, these experiments also show the effect of a rotational speed of the abrasive brushes on peeling quality at a constant distance of 16 mm. Figure 9 shows effect of distance between abrasive brushes and grooved cylinder on the peeling quality at a constant rotational speed of 473 rpm, and Figure 10 shows effect of distance between abrasive brushes and grooved cylinder on peeling quality at a constant rotational speed of 368 rpm for the abrasive brushes.

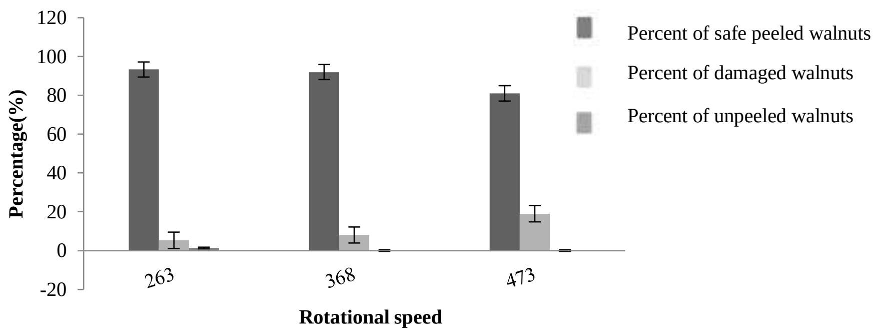

Fig. 8. Effect of different rotational speeds on shelling quality at a distance of 16 mm

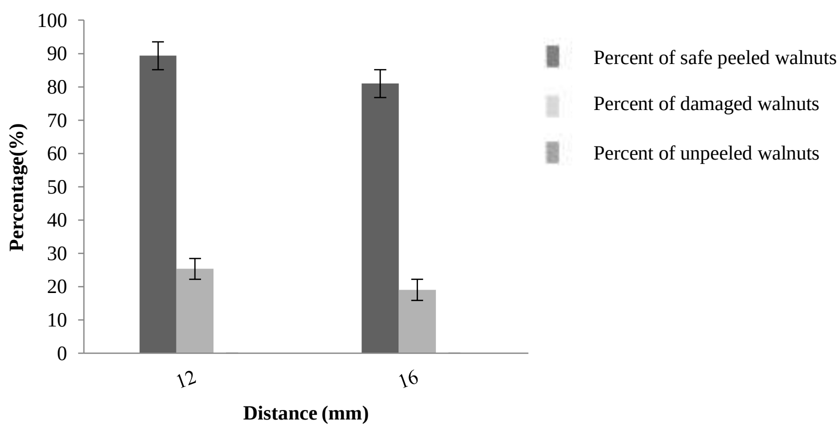

Fig. 9. Effect of different distances on shelling quality at a rotational speed of 473 rpm

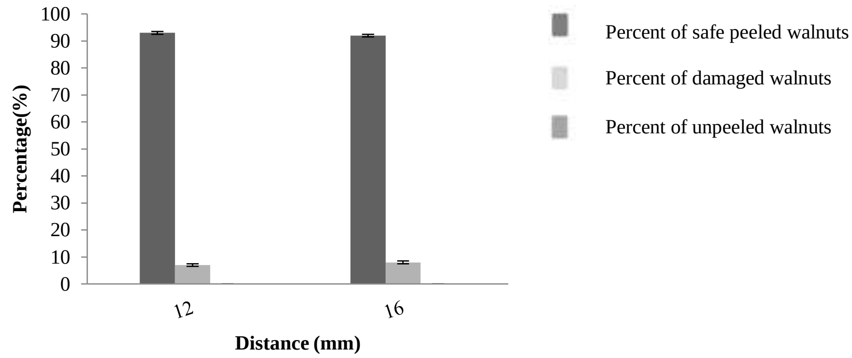

Fig. 10. Effect of different brush distances on shelling quality at a rotational speed of 368 rpm.

The effect of distance on peeling quality at a constant rotational speed of 263 rpm for abrassive brushes is shown in Fig. 11.

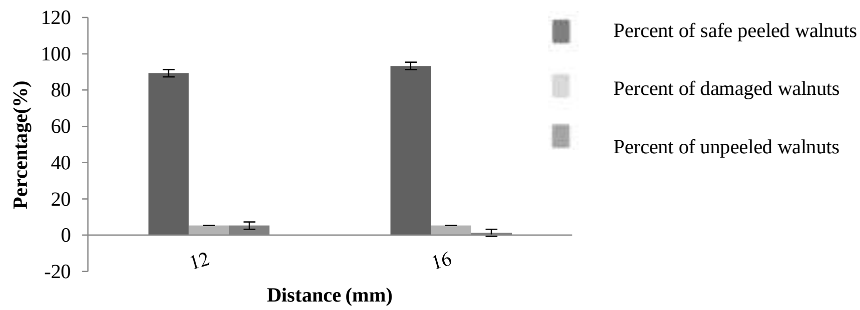

Fig. 11. Effect of different distances on shelling quality at a rotational speed of 263 rpm.

The effect of walnut quantity (25, 50 and 75) on peeling quality is shown at a rotational speed of 368 rpm and a distance of 16 mm in duration of 60 seconds (Fig. 12). Also, Fig. 13 shows effect of walnuts quantity (25, 50 and 75) on peeling quality at a rotational speed of 368 rpm and distance of 12 mm and in duriation duration of 60 seconds.

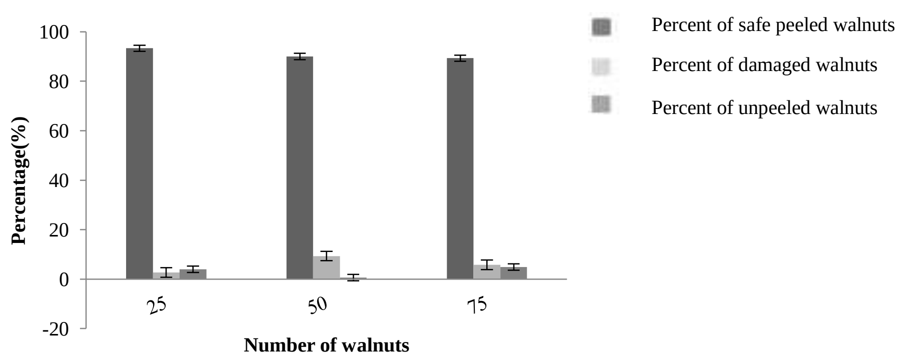

Fig. 12. Effect of walnut quantity on shelling quality with selected conditions
(368 rpm rotational speed and 16 mm distance in 60 seconds).

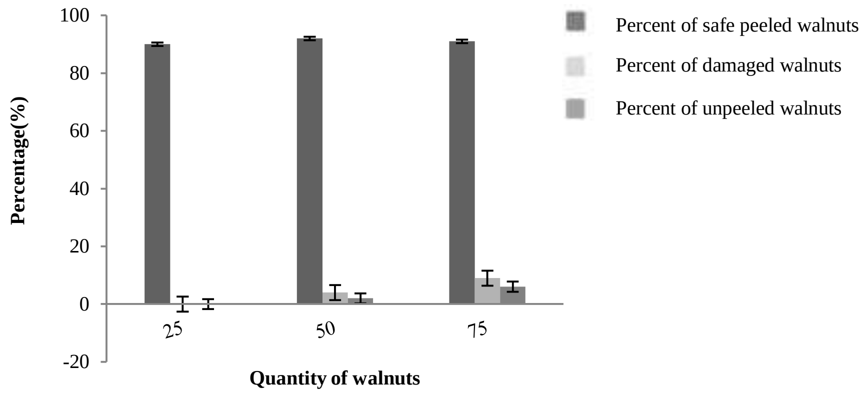

Fig. 13. Effect of walnut quantitys on shelling quality with selected conditions (368 rpm rotational speed and 12 mm distance in 60 seconds).

According to the results the best results were obtained when the rotational speed, distance and quantity of walnuts were 368 rpm, 16 mm, and 25 to 50 nuts, respectively. It should be noted that the duration of this combination was 60 seconds.

Statistical analysis

For statistical analysis of data, SPSS software and finally two-way ANOVA method was used. In two-way ANOVA, the data are classified according to two factors (for example, for an agricultural crop, yields per unit area may be divided based on a variety of seeds and different types of fertilizers that are not completely separated. In the experiments that were analyzed, the effect of time on grain breakage rate, and also in whole peeled walnut percentage, could not be ignored. In this study, Two-way ANOVA analysis was performed on the data by SPSS software; the following results were obtained.

Discussion

The results of analysis of variance of duriations (time of test), distance and rotational speed and also interactions between them are shown in Table. 1.

The interactions of the three parameters in the percentage of whole peeled wlnuts was siginificant in 95%. In the percentage of damaged walnuts, parameters of time (duriation) and rotational speed were siginificant in 99% but distance was not significant.

In evaluation of double interaction between each parameters, results showed that despite of interaction between time (duriation) and rotational speed that is siginificant in 99%, others were not siginificant. Finally the interaction between three parameters in percentage of damaged walnut was not significant.

Table 1. Analysis of variance of time, distance and rotational speed on percentage of whole peeled walnuts and damaged walnuts

Source	Degree of freedom	Mean Square	
		percentage of whole peeled walnuts	percentage of damaged walnuts
Time	8	498.607**	6.376**
Distance	1	51.452**	1.292$^{n.s.}$
Rotational speed	2	1585.487**	57.892**
Time*distance	8	1.568$^{n.s.}$	0.524$^{n.s.}$
Time* rotational speed	16	33.647**	8.687**
Distance* rotational speed	2	20.852**	0.636$^{n.s.}$
Time*distance*rotational speed	16	10.381*	0.635$^{n.s.}$
Error	84	4.975	0.807
Total	120	——	——

Conclusions

To making more coincidence between design assumption and practical conditions, the tests were arranged so as to maximize the percentage of hulled nuts and also the amount of injury rate is minimal while reasonable percentage of hulled walnuts are healthy. Therefore, six combinations of speed and distance were used and each test was performed in three replications and the percentages of whole peeled (hulled) walnuts, unpeeled walnuts and damaged walnuts were found. Because the intensity of performance was dissimilar, different durations were used in each test. Results indicate that increasing the rotational speed, increases the amount of hulled walnuts and the percentage of damaged nuts follows this behavior. If at a constant rotational speed, the distance of abrasive brushes be reduced, the amount of hulled nuts and damaged nuts are raised but the percentage of hulling is more than percentage of injury. It should be mentioned that if the distance of abrasive brushes and the rotational speed are decreased, the peeling rate increased while the damage rate decreased. According to the results the best combination obtained when the rotational speed, distance and quantity of walnuts were 368rpm, 16mm, 25 to 50, respectively. It must be noted that the duration of this combination was 60 seconds.

Acknowledgments

Authors thank College of Abouraihan University of Tehran and Dr. Akbar Arab Mohammad Hosseini (Associate Professor of College of Abouraihan University of Tehran).

References

Bakkalbaşı E, Yılmaz ÖM, Javidipour I, Artık N (2012) Effects of packaging materials, storage conditions and variety on oxidative stability of shelled walnuts. LWT - Food Science and Technology. 46, 203-209.

Çağlarırmak N (2003) Biochemical and physical properties of some walnut genotypes (*Juglans regia* L.). Food / Nahrung. 47, 28-32.

Chegini G, Makarichian A (2014) Design and Construction a Walnut peeler. Journal of Nuts. 5(1), 1-13.

Colarič M, Stampar F, Hudina M, Solar A (2006) Sensory evaluation of different walnut cultivars (*Juglans regia* L.). Acta Agriculturae Slovenica. 87, 403-413.

Feldman EB (2002) The scientific evidence for a beneficial health relationship between walnuts and coronary heart disease. The Journal of nutrition. 132, 1062S-1101S.

Iso H, Sato S, Umemura U., Kudo M, Koike K, Kitamura A, Imano H, Okamura T, Naito Y, Shimamoto T (2002) Linoleic acid, other fatty acids, and the risk of stroke. Stroke. 33, 2086-2093.

Khir R, Pan Z, Salim A, Hartsough BR, Mohamed S (2011) Moisture diffusivity of rough rice under infrared radiation drying. LWT - Food Science and Technology. 44, 1126-1132.

Lavedrine F, Zmirou D, Ravel A, Balducci F, Alary J (1999) Blood cholesterol and walnut consumption: a cross-sectional survey in France. Preventive medicine. 28, 333-339.

Muñoz S, Merlos M, Zambón D, Rodríguez C, Sabaté J, Ros E, Laguna JC (2001) Walnut-enriched diet increases the association of LDL from hypercholesterolemic men with human HepG2 cells. Journal of lipid research. 42, 2069-2076.

Ozcan M (2009) Some nutritional characteristics of fruit and oil of walnut (*Juglans regia* L.) growing in Turkey. Iranian Journal of Chemistry and Chemical Engineering. 28(1), 57-62.

Ozkan G, Koyuncu MA (2005) Physical and chemical composition of some walnut (*Juglans regia* L.) genotypes grown in Turkey. Grasas y Aceites. 56, 141-146.

Rajabipour A, Shahbazi F, Mohtasebi S, Tabatabaifar A (2010) Airflow resistance in walnuts. Journal of Agricultural Science and Technology. 3, 257-264.

Savage G (2001) Chemical composition of walnuts (*Juglans regia* L.) grown in New Zealand. Plant Foods for Human Nutrition. 56, 75-82.

Xu H, Yan S, Wang Y, Liu M (2012) Study on the Walnut Mechanical Characteristics and Shucking Technology Based on Finite Element Analysis. In: Li D, Chen Y. (Eds.), Computer and Computing Technologies in Agriculture V. Springer Berlin Heidelberg. Pp. 577-586.