Turkish Journal of Agricultural and Natural Sciences
Special Issue: 2, 2014

TÜRK
TARIM ve DOĞA BİLİMLERİ
DERGİSİ

TURKISH
JOURNAL of AGRICULTURAL
and NATURAL SCIENCES

www.turkjans.com

Study On The Influence Of Different Drying Modes Over The Chemical Composition Of Organic Fruits Of Some Plum Cultivars

Diyan GEORGIEV[a], Mariya GEORGIEVA[a], Boryana BRASHLYANOVA[b], Ognyan KARABADZHOV[B]

[1]Research Institute of Mountain Stockbreeding and Agriculture – Troyan
[2]Food Research and Development Institute – Plovdiv
E-mail: d_georgiev_@abv.bg

Summary

The change of some biochemical indicators of fruits of some plum cultivars was followed under the influence of different equipments and drying modes. In the first variant for the process of drying was used an alternative energy source – solar energy, and in the second one – a heat pump.The highest dry matter content was found in the fresh fruits of Mirabelle de Nancy – 25.50 %. In the alternative source of drying of fruits, Gabrovska cultivar had the highest content of biological active substances (ascorbic acid – 8.80 mg%) and Stanley (anthocyanins – 40.81 mg %). In the heat pump drying of fruits, Stanley had the highest content of both components.

Key words: plum, dried fruits, chemical composition, solar dryer, heat pump

Introduction

The environmental issues related to global warming impose urgent measures to be taken in order to reduce the use of fossil fuels and to introduce energy saving (low carbon) or zero carbon (from the renewable sources) technologies.

Drying is the oldest and most secure way to store food and its qualities. Dietary fibers, carbohydrates, minerals and vitamin A are resistant to dehydratation (Brennand, 1994; Thomas & Berry, 1997). Meanwhile dried products are more environmentally friendly because of less packaging, lower transport costs, lower pollution (Harrison and Andress).

Fruit drying is however one of the methods of preservation related to the use of a significant fuel amount or electric energy per unit of product. The use of solar energy for this process is an alternative to the traditional fuels (Karabadzhov et al., 2011). Solar drying could be applied successfully by small agricultural producers throughout the whole country. The introducing of such equipment, besides the environmental benefit, will contribute for increasing the assortment structure and the cultivar diversity of dried products.

The advantages of techniques and technologies for the low temperature heat pump drying lies in obtaining of a final product at a lower specific energy consumption of electric energy for the evaporation of 1 kg of water and environmental efficiency. The heat pump drying provides controllable conditions for drying (temperatures and humidity) for a better quality of products (Patel & Kar, 2011).

A particular interest would provoke dried products, produced by raw materials, obtained in environmentally clean regions in our country.

The aim of present study is to follow the change of some biochemical indicators of fruits of different plum cultivars under different equipments and modes of drying.

Materials and Methods

As an object of the study are chosen plum cultivars Stanley, Gabrovska and Mirabelle de Nancy, which were obtained from the demonstrative plantation of RIMSA – in the town of Troyan. The scientific experiment was conducted in 2013.

Fruits were washed, stones were removed, and then they were cut by hand into eights. In order to avoid conglutination of the finished dried product before arranging the sliced plums, they were washed and drained, after that they were laid on the working surface (trays). In order to eliminate the subjective factor during drying and to determine the maximum duration of the process under the particular conditions, plums were not stirred.

In the first variant of drying, fruits were dried in a solar dryer. The main advantage of that type of dryers is that the product is dried by warm air without direct sunlight. The period for drying depends on the ambient temperature, intensity of sunlight, the size and type of product, as well as the thickness of the layer (Karabadzhov et al., 2011; Mitrovich et al., 2013). The fruit drying experiments were conducted in one cycle. The separate batches were supplied respectively on 20.08.2013. Both samples were conducted in stable sunny weather, at ambient temperature ranging between 22-24°C in the morning and 30-35°C in the early afternoon hours. Depending on ambient conditions, drying temperature was determined in the interval 30 to 50°C.

In the second variant the experiment was conducted at FRDI – Plovdiv on heat pump stand at an initial temperature 45ºC and circulating air with initial moisture content 8-10% and speed of 4.6 $m.s^{-1}$. The process occurs in a thin layer in transverse air flow against the layer of the product till reaching the constant weight of the sample.

The biochemical composition of the raw material and the dried plum was tested at the chemical laboratory of RIMSA-Troyan for the following biochemical indicators:

►Total dry matter %;

► Total and reducing sugars % - according to the method of Shoorl-Regenbogen;

►Acids % - by means of titrating by 0.1 n NaOH;

►pH (active acidity) – potentiometrically;

► Content of ascorbic acid (mg/%) according to the method of Fialkov;

►Anthocyanins (mg/%) – according to the method of Fuleki and Franciss;

For processing the results a multiple comparison was applied according to Duncan's method (SPSS Statistics 19).

Results and Discussion

Biochemical composition of fruits depends on the cultivar diversity and the habitat of plants. It was followed for Stanley, Gabrovska and Mirabelle de Nancy plum cultivars after gathering, solar and heat pump drying (Table 1, 2 and 3). In order for the results to be comparable, data were reduced to absolute dry matter.

Table 1. Biochemical composition of fresh and dried plum fruits in different regimes of Stanley cultivar*

	Cultivar	Total sugars, %	Inverted sugar, %	Sucrose, %	Acids (as the apple), %	Ascorbic acid, mg/%	AnthocyaniNs, mg	Dry weight, %
Stanley	raw material	62.40a	38.65a	22.58a	2.60a	82.61a	36.50b	18.11
	solar drying	15.58c	11.95c	3.45c	0.59c	7.71c	51.08a	79.90
	heat pump drying	22.96b	14.46b	8.08b	0.72b	11.35b	20.63c	93.02

*Results were reduced to absolute dry matter

The total dry matter was measured, an indicator which is necessary for the degree of drying of fruits. It was within the range from 18.11 % (Stanley) to 25.50 % (Mirabelle de Nancy).

The multiple comparison proved significant differences in the chemical composition of plum fruits for both variants of drying (p=0.05).

Stanley and Gabrovska cultivars were distinguished by a higher initial content of total sugars. Regardless of the method and mode of drying applied, a tendency towards a distinct decrease was determined in the total sugars content in the three plum cultivars, as it was more significant for the solar dried fruits. The change in the inverted sugar in the drying process followed the tendency, outlined by the total sugars.

The slightest content of sucrose was found in the fruits of Mirabelle de Nancy, and the highest in Gabrovska cultivar. The sucrose content in the heat pump dried fruits was considerably higher than that in the solar dried plums of Stanley and Mirabelle de Nancy cultivars, but it was differentiable than sucrose in the fresh ones. There was an exception for Gabrovska cultivar, where the solar drying preserved in a higher degree the content of sucrose.

The content of acids was the lowest for Mirabelle de Nancy and three times more for Gabrovska cultivar, as it could be assumed it was a cultivar characteristic. The acids content decreased distinctly and was preliminary equal for both modes of drying, but it was higher for heat pump dried cultivars of Stanley and Gabrovska and lower for Mirabelle de Nancy.

Significant differences were also reported in the values of ascorbic acid, both among the cultivars and between the both modes of drying. In the solar drying, the fruits of Mirabelle de Nancy had the lowest content and it was significantly more for Gabrovska. Heat pump drying, however, preserved the higher values of ascorbic acid for Stanley and Mirabelle de Nancy.

Table 2. Biochemical composition of fresh and dried plum fruits in different modes of Gabrovska cultivar*

	Cultivar	Total sugars, %	Inverted sugar, %	Sucrose, %	Acids (as the apple), %	Ascor bic acid, mg/%	Anthoc yani Ns, mg	Dry weight, %
Gabrovska	raw material	62.19a	35.96a	24.93a	3.00a	87.91a	57.19a	20.02
	solar drying	19.36c	14.18c	4.92b	0.82c	11.24b	29.46b	78.27
	heat pump drying	29.91b	27.49b	2.31c	1.00b	8.12c	12.65c	86.75

* Results were reduced to absolute dry matter

Table 3. Biochemical composition of fresh and dried plum fruits in different modes of Mirabelle de Nancy cultivar*

	Cultivar	Total sugars, %	Inverted sugar /%	Sucrose, %	Acids (as the apple), %	Ascorbic acid, mg/%	Antho Cyanins, mg	Dry weight, %
Mirabelle de Nancy	raw material	50.78a	36.86a	13.22a	1.06a	79.37a	11.37a	25.50
	solar drying	14.40c	11.67c	2.59c	0.42b	3.28c	0.81c	80.57
	heat pump drying	20.76b	13.00b	7.37b	0.31c	10.12b	2.78b	86.93

*Results were reduced to absolute dry matter

The influence of cultivar and mode of drying over the change of anthocyanins was expressed to the highest extent. In their content was found statistical difference, without common tendency depending on the applied drying. Anthocyanins content was likewise the lowest for Mirabelle de Nancy, because of the brighter nuance of fruit and it corresponded to the lower content in fruits for both drying modes. For them the heat pump drying was more favourable in view of preservation of anthocyanins in fruits, while for Stanley and Gabrovska – it was the solar one.

Our results, regarding preservation of biochemical indicators of plum fruits after drying, give us the reason to recommend them for inclusion in our daily menu.

Conclusions

The proportion between sugars and acids, which gives the good taste, both for the fresh, as well as for the dried fruits, is preserved in the solar drying. Plum fruits of Stanley cultivar, both in heat pump and solar dried ones, had values, which were closest to those of fresh fruits.

Heat pump drying provides preservation of bioactive components in a greater extent for fruits of Mirabelle de Nancy, and the solar drying for Gabrovska cultivar.

REFERENCES

1. KARABADZHOV O., M. TODOROV, P. PARASKOVA, D. GEORGIEV. Solar energy utilization for preparing of dried plant products, Journal of Mountain Agriculture on the Balkans – Troyan, vol.14, No 4, 932-939, 2011.
2. MITROVICH O., V. NEDOVICH, B. ZLATKOVICH, M. KANDICH, B. POPOVI`, N. MILETI`, A. LEPOSAVICH. Influence over time for drying caused by the characteristics of fresh plum fruits of "Chachanska rodna" and "Milorda" cultivars, Journal of Mountain Agriculture on the Balkans, vol. 16, 1, 66-82, 2013.

3. BRENNAND CH.P. Home Drying of Food. UtahState University. Cooperative Extension. FN-330, 1994.
4. HARRISON J.A., AND E.L. ANDRESS. Preserving Food: Drying Fruits and Vegetables, The University of Georgia Cooperative Extension, www.Uga.edu/nchfp/publications/uga/uga_dry_fruit.pdf.
5. PATEL K.K., KAR A.B. Heat pump assisted drying of agricultural produce - an overview. J Food Sci Technol., 49 (2): 142–160, 2011.
6. THOMAS T.H. & H. BERRY. Drying Fruits and Vegetables, Washington State University, Cooperative Extension, 665. A. HS0005, 1997.