Madzgharashvili, G. (2016). Optimization of concentration conditions for food products with high humidity. *World Journal of Biology and Biotechnology, 1*(1), 39-42
DOI: https://doi.org/10.33865/wjb.001.01.0004
(Online) ISSN 2522-6754 2016 (Print) ISSN 2522-6746
WORLD JOURNAL OF BIOLOGY AND BIOTECHNOLOGY
Volume: 01 www.sciplatform.com Issue: 01

OPTIMIZATION OF CONCENTRATION CONDITIONS FOR FOOD PRODUCTS WITH HIGH HUMIDITY

Giorgi Madzgharashvili
Demetra limited G. Saakadze street, 0180, Tbilisi, Georgia
Corresponding email address: gmadzgarashvili@yahoo.com

ABSTRACT

According to the research, for improving the properties of unripe and partly sour honey, its concentration can be achieved by increasing the evaporation surface area of the products to be processed in vacuum conditions as well as in an open boiler under the recommended mode for heating honey (up to 45 °C). To stabilize fruits and accelerate the process of concentration in the liquids as well as mechanical mixtures of liquids for jams and fruit purees, it is recommended to premix the pulp with food sugar enzymatic hydrolysate (invert sugar), then obtain the mix at relatively moderate temperature (55-60°C), for which the intensive thickening technology has been developed using the above-mentioned method (Copyright of deposition #5870,2014, "Sakpatenti") and easily oxidizable substances of fruits are protected in gaseous nitrogen stream. Due to these changes, honey, invert sugar syrup, fruit juices and fruit pulp preserve their original properties, hydroxymethylfurfural (HMF) content in the finished product was within 0.5-5.0mg/kg, decrease of water content was 17-20 mass % in an hour, if the liquid mass concentration of the mixture was 23-64 mass%. This paper contains 1 table, 7 figures and 6 literary sources. Materials of the research, which formed the basis for the development of new technology, have not been published in any other source of scientific information.

Key word: Concentration, evaporation surface area, invert sugar, honey, jam, fruit purees, hydroxymethylfurfural.

INTRODUCTION

In food processing technology the reduction of water content and the maintenance of fruit in the form of commodity is still quite a complex issue, which is due to various reasons: these products are usually less thermo-stable and high temperature used in processing becomes the cause of irreversible transformation; in the above mentioned products the simultaneous presence of organic acids and sugars during processing at high temperature determines the emergence of undesirable substances (e.g. Hydroxymethylfurfural); fruit membrane damage leads to rapid oxidation of the content; The lower the degree of pulping, the lower the intensity of moisture release from the fruit, the higher the atmospheric pressure on the surface of the material to be processed and the level of the solution to be evaporated. At present in the most progressive method of drying vacuum, drying of material accelerates the process of the intensity twice and reduces power costs required for its implementation.

In addition, there is one interesting event to be mentioned: intensive drying of wet material (e.g. tissue structure) occurs under low temperature conditions, if the material bound water has a large area of contact with the atmosphere. Accordingly, evaporation surface area is more important for intensifying the process of evaporation, and the temperature increase required for evaporation is less effective. Drying machines available at present, regardless of their types (open boiler, vacuum evaporator, and vacuum freeze drier, spray driers, subliminal machines and others), do not correspond the natural way of evaporation that should be considered during the creation of new designs.

The objective of this study was conducted as follows

1. Creating a drying device to obtain product of industry from agricultural products, in which evaporation surface area will be increased multiple times for removing excess moisture from products;
2. Minimizing processing temperature without any delay in the intensification of the evaporation process in the device;
3. Avoiding the emergence of harmful substances and oxidation of content of the products to be processed;
4. Maintaining marketability (color, smell and taste properties) of the product as much as possible.

METHODOLOGY

In I series of experiment: white cherry and peach jams, unripe and partly sour honey and tangerine juice. For experimental selection as far as possible it was giving priority to the light (white) staining incipient material, to demonstrate more contrasting changing of color after processing, particularly at the figure it is represent jam of white cherry without stones (Madzgarashvili *et al.*, 1983). Here is presented jam made from the same material by the enterprise "Kula" (Madzgharashvili, 1977), comparison of them gives to reader the possibility to estimate our elaborated technology. At the figure there is shown jam of peach made by us (TOCT, 1998) for comparison it is taken material (products, 2012) peeled and sliced peach, because why we couldn't find industrial kind of the production. Minor change of color of processed peach must be influence of glassware. At the figure no. 3there is shown unripe and partially sour honey of chestnut and the same material after processing according our technology, although it is difficult to establish visual change between them. The same situation is in the concentrates of tangerine juice presented at the picture

(ТОСТ, 1998), from them example 8 was made by us, and example 9 was made by Juice factory of town Kobuleti. Between them we established difference of color using photo colorimeter, about what the reader will induction below.

In the II Series: pear, apple and quince fruit purees. At the II series of experiments were made purees from apples, quinces and pears. From apple purees #6 was made by us and N7 is production made by the enterprise "Kula". Analogical quince puree N8 was made by us and N9 –at the enterprise "Kula". At the figure # 11there is shown pear puree made by us, we couldn't find industrial analogue of pear puree at the market and accordingly we couldn't present it here.

Material, processing temperature (Celsius)

1. Honey at the initial stage 44 °C; at the final stage 48 °C;
2. Other materials: 44 °C at the initial stage, and 58-62°C at the final stage;
3. Concentration in material, mass %:
4. Invert syrup-53-69.8;
5. Jams (final)-81.5-82.7;
6. Fruit purees (final) -68-70
7. -Honey (initial)-74; Final-82.4;
8. -Tangerine juice: Initial-13.5; Final -82.4;

Experimental device: a 2-body boiler with heater, with special equipment for multiple increase of evaporation surface area, with no moving parts; for processing fruit purees - the use of gaseous nitrogen stream;

Preparation of materials for the experiment and implementation: Honey removal of suspended foreign substances (wax, etc.) by means of filtration and further concentration; Invert syrup impact of ferment β-fructofuranosidase on the concentrated solution of sugar for hydrolysis;

Jams and fruit purees cutting and breaking down into purees, mixing with invert syrup and concentration (in case of fruit purees in gaseous nitrogen stream);

Tangerine juice- filtration and concentration;

Evaluation and implementation of research methods:

Determination of solution concentration using Refractometer, RL-2 brand device (Pol.), with the possibility to establish 0-85%; study of color, smell and taste properties organoleptical, in some cases determination of color change using КФК 2МП mark (Rus) photoelectrocolorimeter;

Determination of hydroxymethylfurfural (HMF) content in accordance with ГОСТ 31644-2012 mg/kg (products, 2012).

Note: The material consisting of various components was undergone intensive mixing during processing, therefore the finished products (with the exception of solid ingredients) were homogeneous. Due to this, one sample was taken from each lot of separate product, and the analysis was made on two tests. The composition of the products mentioned in the article is considered to be the average index for all the samples tested.

RESULTS AND DISCUSSION

The further task for developing new technology for thickening solutions consisted in the optimization of temperature in the material to be processed. In the water jacket of the equipment it was 75-80°C, 44.5-60°C in products to be processed depending on their type (Table 1). In particular, for unripe honey this figure was 66-70°C and 44-48°C accordingly. The most intense emission of steam from tangerine juice was observed in 23-43.5 mass % concentration (2.93min. per mass % of moisture separated); in case of invert sugar its average rate was 5.3 minutes, and for unripe sugar - about 8 minutes. The time (in minutes) spent on concentration of products was counted from the beginning of the process in each specific case.

Photo materials of the finished products are given below. Concentration of factory produced white cherry jam was 64%, in samples #2 and 4 produced by us 83 and 83.5% accordingly. Color difference between them would be more contrasting in case of increasing the concentration in sample #3. Darkening in this material is caused by high temperature required for its sterilization; this was not necessary in samples #2 and 4 (impact of high concentration).

These data demonstrate that the intensity of evaporation is much less at the final stage of processing of highly concentrated products because of the limitations of used temperature. In particular, 12 minutes was spent for 77.5-80.5% thickening of invert syrup by increasing concentration with 1%, and 4 minutes in case of increase 53-68%. In the processing of unripe honey (74-82.4%) the same indicator is 7.98 minutes.

And as for tangerine juice, here's a different picture: in the beginning (13.5-23%) the perceived intensity of evaporation is less (6.3 minutes), then it increases by decreasing the time spent to 3 min, but this is due to the low initial concentration of tangerine juice (absolute index of moisture release is higher).

The results achieved are particularly important for unripe honey, especially due to the new trend of reducing water content to 17-17.5% in this product, which is quite difficult to achieve in apiaries located in high humidity zones. In our experiment for increasing concentration from 73.5 to 82.4 % less than 83 minutes was recorded compared to the respective analogue (Madzgharashvili, 1977).

In the samples of the product, where the difference of colors is not visually observed, after concentration by different technologies, transparency at 340nm wavelength in 1cm wide cells was determined. The concentration of solutions was 0.75%.The results are as follows: it was 1,092 in tangerine juice concentrate produced by new technology, in the sample prepared in traditional manner- 2,128, in invert syrup - 0,041, in natural Golden Birch honey - 0,076, and in deodorized Golden Birch honey - 0,105.

In the process of preparing fruit purees the material was processed according to the same scheme: fruit raw materials after breaking into purees were mixed with invert syrup, the mixture was thickened by a radical increase of evaporation surface area, in atmospheric air flow, but unlike jams, there was a drastic change of color towards darkening, which also

Fig. 1: Different types of products use in this study.

Product to be Processed	Concentration , mass % at different stages							Temperature of the solution	
	Initial	Minute	%	Minute	%	Minute	%	Initial	Final
Invert syrup	69,7	40	75,0	60	78,0	90	80,6	45	49
Invert syrup	69,8	43	74,0	60	77,5	96	80,5	45	50
Invert syrup	53,0	6	58,5	54	68,0	126	82,0	44	51
Unripe honey	74,0	41	79,0	67	82,4	----	----	44	48
Tangerine juice	13,5	60	23,0	120	43,5	----	----	38,5	44,5

Table 1. Thickening process dynamics of the material to be processed.

continued during storage of the finished product. This was due to the impact of atmospheric oxygen, after which the mixture of fruits and inverted syrup was thickened in gaseous nitrogen stream. This change provided for the complete maintenance of the original characteristics: color, taste and smell were typical of natural products, as shown in figures 1. In this case, products of the similar origin produced according to traditional technology by the "Kula" enterprise are presented as control samples. In addition to natural products characteristics, the samples were analyzed on hydroxymethylfurfural content at "Multitest" testing laboratory (products, 2012). Results are given below (mg/kg):

In Invert syrup -<5,0

In pear fruit puree (#11) -0.6

In pilot sample of apple fruit puree (#6) -0.5; in factory sample (#7)-148.0;

In pilot sample of quince fruit puree (#8) -1.5; In factory sample(#9)-731.2.

As we can see, indicators are very different in favor of new technology. And as for invert syrup, this product is to be considered completely safe for human and bees needs; in addition, if we take into account that its content in even natural honey is allowed up to the amount of 40mg/kg according to Euro standard scheme, everything is clear.

CONCLUSIONS

1. The major factors for improving industrial processing technology for thermolabile agricultural products are as follows: minimum temperature mode for evaporating extra water, protection of easily oxidable substances using mixture of simple sugars (fructose, glucose) and avoidance of negative impact of atmospheric oxygen in gaseous nitrogen area, by the implementation of process in closed technological circuit;
2. During concentration of solutions and liquid mechanical mixtures it is important to increase evaporation surface area instead of increasing temperature; this process can be carried out in a boiling device of simple design; evaporation surface area per one unit of the processed material should exceed the volume of the material 20 times, in vacuum evaporator the same indicator should be more than 7 times.
3. Conducting the process in the above mentioned conditions allows the dehydration of the material to be processed at 45- 60 °C, and the temperature of heat-carrying agent should be 75-80°C; the intensity of the process includes reduction in moisture by 17-20% per hour, if the material concentration is within 23 - 64 mass%. Processing under these conditions maintains product marketable appearance, prevents the appearance

of harmful substances and significantly reduces energy costs required for concentration.

ACKNOWLEDGEMENTS

The author would like to thank Revaz Sakvarelidze, UNDP Project Manager for adequate assistance to the author for preparation and introduction of method of using invert syrup in beekeeping practice in Georgia, and Mr. L. Kalandadze, director at "Multitest" LTD, for the analysis of product samples produced by the author, that prove the advantages of food products processing by new method.

REFERENCES

Madzgarashvili, G., Alanya N and N. Bregadze, 1983. Method of disposal of toxic honey. AS Number 1211907: 1/08.

Madzgharashvili, 1977. Process for producing sucrose hydrolyzate. A.C. № 578341 13(3).

products, J., 2012. Determination of 5 hydroxymethylfurfural (hmf) by high performance liquid chromatography (hplc) method.

TOCT, 1998. Honey quality standard according to the draft CL 1998/12-S of the Codex Alimentarius and to the Draft 96/0114((CNS) of the EU).

Date Published (D-M-Y): 15-4-2016