v. 4, n. 82, 2024

International Journal of Health Science

DEHYDRATION OF GINGER (*ZINGIBER OFFICINALLE* ROSCOE) AND ITS EFFECT ON WATER FLAVORING

Leonardo Henrique Martim Lago
Food Engineering student - Technology Department - Universidade Estadual de Maringá (UEM)

Lucídio Molina Filho
Professor of Food Engineering - Department of Technology - Universidade Estadual de Maringá (UEM)

Carolina Castilho Garcia
Lecturer in Food Engineering - Universidade Tecnológica Federal do Paraná – Câmpus Medianeira

Gláucia Cristina Moreira
Lecturer in Food Engineering - Universidade Tecnológica Federal do Paraná – Câmpus Medianeira

Keila de Souza Silva
Lecturer in Food Engineering - Department of Technology - Universidade Estadual de Maringá (UEM)

Abstract: Ginger has a number of components that have aroma, pungency and medicinal properties. The intensity of these compounds depends on various factors, including the increase in temperature. The aim of this study was to evaluate the drying kinetics of ginger at different temperatures and to check the influence of drying temperature on the transfer of compounds to flavor water. It was found that increasing the drying temperature favored the transfer of energy in the form of heat, reducing the time needed to reach equilibrium. The equilibrium humidity of the samples was obtained in 300 minutes for T = 80 °C, 330 minutes for T = 70 °C and 420 minutes for T = 60 °C. Flavored waters made with ginger previously dried at 80 °C imparted greater flavor intensity than those made with ginger dried at 60 and 70 °C
Keywords: Flavored Water; Drying; Sensory Analysis.

INTRODUCTION

Ginger is a spice that has been growing worldwide and deserves to be highlighted because its application spans the food and pharmaceutical industries and it has scientifically proven properties such as antimutagenic, antiemetic and antinausea, anti-inflammatory, antiulcer, hypoglycemic and antibacterial activities. Most of the ginger trade takes place *in its natural* form, but it is also widely sold in canned and dried form. Drying ginger allows its moisture content to be reduced from 80% to 12%, so it is also sold in the form of whole pieces, slices or powder, the latter being less common. Ginger has several characteristic components, including essential oils and oleoresin. These perform the function of aroma and pungency, respectively. Essential oil consists mainly of monoterpenoid hydrocarbons and sesquiterpenes, while oleoresin is composed of non-volatile phenols known as gingerols, shogaols and gingerone (ELPO; NEGRELLE, 2004; HUANG et al., 2012).

Gingerols are characterized as the main active components *in fresh* ginger. The compound shogaol, on the other hand, is not present in the fresh sample, as these are products of the degradation of gingerol through long-term storage, thermal processing (such as drying) or contact with an acidic environment (KUBRA; RAO, 2012).

The drying process consists of partially removing the water contained in the product until it reaches the predefined water content. It is an operation that involves the simultaneous transfer of mass, heat and quantity of movement, and is one of the most complex unit operations. If it is carried out improperly, it can reduce the quality of the product and even accelerate the deterioration process (FILHO; MELO, 2001; BIAGI; BERTOL; CARNEIRO, 2002).

The aim of this proposal is to evaluate the drying kinetics of ginger and the acceptability of water flavored with ginger dried at different temperatures.

MATERIALS AND METHODS

SAMPLE PREPARATION

The raw material used in the experiments was purchased from a local shop in the city of Umuarama-PR and stored under refrigeration at 5 °C for 7 days. To carry out the experiments, the rhizomes were washed under running water and the excess water was removed with a clean, dry cloth. Using a knife, the rhizomes were peeled, cut into pieces 3-5 mm thick and placed on baking sheets to dry.

DRYING KINETICS

After washing and cutting the raw material, the ginger slices were placed on aluminum trays. They were taken for drying in an oven with forced air circulation (MARCONI, model MA-035, Piracicaba, SP) which had previously been heated to the desired drying conditions. The samples were dried at temperatures of 60, 70 and 80 °C.

The operation was carried out in duplicate and the drying curves were obtained by weighing every 15 minutes from the beginning to the third hour; every 30 minutes from the third to the sixth hour; and every 1 hour from the seventh to the tenth hour. Equilibrium humidity was obtained by letting the ginger sample dry in the oven for 24 hours. All mass measurements were taken on a semi-analytical balance (MARTE, model UX420H, São Paulo, SP).

The moisture content was determined in triplicate in an oven at 105 °C for 24 hours (INSTITUTO ADOLFO LUTZ, 1985).

The ginger drying curves were constructed from the experimental data based on the dimensionless moisture content (Equation 1) and in relation to the drying time obtained for the different temperatures. Excel software was used to perform the calculations and construct the graphs.

$$Y = \frac{\overline{X}_t - X_{eq}}{X_0 - X_{eq}} \tag{1}$$

Where: $\overline{X}_t$ is the humidity at each time interval; X_{eq} is the equilibrium humidity; X_0 is the initial humidity of the solid; Y is the dimensionless humidity.

SENSORY ANALYSIS

The tests were carried out at the Sensory Analysis Laboratory of the Technology Department of the State University of Maringá (UEM) Umuarama regional campus, in individual booths. The samples, approximately 0.900 g, were immersed in 50 mL of cold water at the time of serving, arranged in individual plastic cups coded with random three-digit numbers, and the tasters were asked to shake for 15 seconds before carrying out the test. A total of 100 random, untrained tasters were used, who were interested and available to carry out the tests.

The three samples were served simultaneously in disposable cups and the tasters were asked to rank the samples in ascending order of flavor intensity. The results were statistically evaluated using the table for the Newell and Mac Farlane ranking test, which defines the value of the critical differences between the ranking totals at the 5% level (DUTCOSKY, 2007).

STATISTICAL ANALYSIS

The results were expressed as means ± standard deviation and analyzed using Analysis of Variance (ANOVA) and the Tukey test, considering a significance level of $p < 0.05$, using the STATISTICA program (Realese 7, StatSoft, Inc, Tulsa, USA).

RESULTS AND DISCUSSION

The drying process of the ginger samples at temperatures of 60, 70 and 80 °C was described using the drying curves in terms of the dimensionless humidity (Y) as a function of time (Figure 1). This range was established because, according to Huang et al. (2012), from 70 °C gingerol loses one molecule of water, thus becoming the compound shogaol. This is desirable in order to verify the influence of these compounds on the aromatization of water.

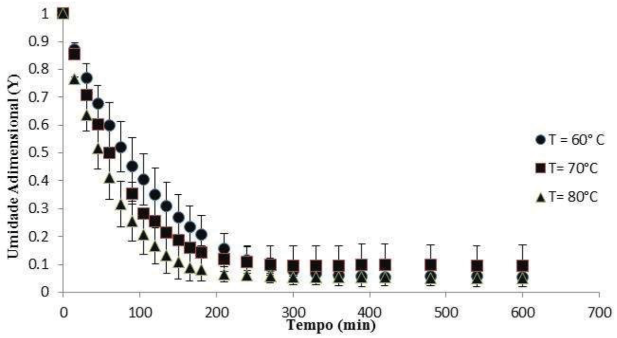

Figure 1: Dimensional humidity (Y) *versus* drying time for the ginger samples at the different temperatures.

It was found that increasing the temperature favored the process of transferring energy in the form of heat, reducing the time needed to reach equilibrium. The equilibrium humidity of the samples was obtained in 300 minutes for T = 80 °C, 330 minutes for T = 70 °C and 420 minutes for T = 60 °C.

Table 1 shows the data for the sensory sorting test.

	T = 60 °C	**T = 70** °C	**T = 80** °C
Flavor Intensity	1.33 ± 0.58[a]	1.78±0.52[b]	2.90±0.30[c]

Table 1: Sorting test.

Mean ± standard deviation. Different letters on the same line differ according to Tukey's test (p≤0.05).

There was a significant difference between the samples in terms of flavor intensity. This is related to the non-volatile oleoresins that give ginger flavor, aroma and therapeutic properties, as well as little degradation into phenolic compounds and flavonoids (BARRETO; TOSCANO; FORTES; AN, 2016).

According to Pereira et al. (2007), phenolic compounds such as gingerol, shogaol and gingerone give ginger pungency, chemical stability, aroma and antioxidants. 6-gigerol is an aromatic compound present *in fresh* ginger, and is classified as thermolabile, undergoing retro-aldolic thermal degradation. This degradation modifies the structure of gingerol, allowing a molecule of water to leave its structure, resulting in shogaol, which is an oleoresin with much greater pungency, aroma, flavor and anti-inflammatory properties than gingerol. Through the drying process, this degradation began to occur from the temperature of 70 °C, intensifying the presence of non-volatile phenols that give ginger such characteristics (HUANG et al., 2012; KUBRA; RAO, 2012).

Huang et al. (2011) compared the formation of shogaol at temperatures of 60 and 70 °C and found no significant difference, but at 80 °C they found a high formation of this compound. Considering the aforementioned reference and the data reported in Table 1, it can be said that the sample dried at 80 °C had a higher flavor intensity due to the higher concentration of shogaol, when compared to the other lower temperatures.

Drying is necessary for most foods, but it negatively degrades the product, leading to nutritional and sensory losses. However, for the use of ginger in flavoring water, drying at high temperatures is to some extent welcomed, as it intensifies the characteristics of ginger compared to the rhizome *in its natural* state.

CONCLUSIONS

The results showed that increasing the temperature from 60 to 80 °C reduced the drying time of ginger by 120 min. Waters flavored with ginger previously dried at 80 °C gave a greater intensity of flavor than those made with ginger dried at 60 and 70 °C.

ACKNOWLEDGMENTS

The authors would like to thank CNPq (Process 405406/20169) and Fundação Araucária (Proc. 10884/2016) for their financial support.

REFERENCES

AN, K.; ZHAO, D.; WANG, Z.; WU, J.; XU, Y.; XIAO, G. Comparison of different drying methods on Chinese ginger (*Zingiber officinale* Roscoe): Changes in volatiles, chemical profile, antioxidant properties, and microstructure. **Food Chemistry**. v. 197, Part. B, p.1292-1300, 2016.

BARRETO, A. M. C.; TOSCANO, B. A. F.; FORTES, R. C. Efeitos do gengibre (*Zingiber officinale*) em pacientes oncológicos tratados com quimioterapia. **Ciências Saúde.** v. 22, n.3, p. 257-260, 2011.

BIAGI, J.D.; BERTOL, R.; CARNEIRO, M.C. Secagem de grãos para unidades centrais de armazenamento. In: LORINI, I; MIKE, L.H.; SCUSSEL, V.M. (Eds.). Armazenagem de grãos. Campinas, **Instituto Bio Geneziz**, 2002. 289-3074 p.

DUTCOSKY, S.D. **Análise sensorial de alimentos**. Curitiba: Champagnat,2007. 123 p

ELPO, E. R. S.; NEGRELLE, R. R. B. *Zingiber officinale* Roscoe: Aspectos botânicos e ecológicos. **Visão Acadêmica**, Curitiba, v. 5, n. 1, p. 27-32, 2004.

FILHO, A.F.L; MELO, E.C. Racionalização de energia no processo de secagem de café. In: ZAMBOLIM, L. (Ed.). **Tecnologias de produção de café com qualidade**. Viçosa: UFV, 2001. 527-564 p.

HUANG, B. K.; WANG, G. W.; CHU, Z. Y.; QIN, L. P. Effect of oven drying, microwave drying, and sílica gel drying methods on the volatile components of ginger (*Zingiber officinale* Roscoe) by HS-SPME-GC-MS. **Drying Technology**. v. 30, n. 3, 248-255, 2012.

HUANG, T. C.; CHUNG, C. C.; WANG, H. Y.; LAW, C. L.; CHEN, H. H. Formation of 6-shogaol of ginger oil under different drying conditions. **Dryind Technology: An international Journal**. v. 29, n.16, p.1884-1889, 2011.

INSTITUTO ADOLFO LUTZ. **Normas analíticas do Instituto Adolfo Lutz.**3ª ed.I.A.L., 1985. KUBRA, I. R.; RAO, L. J. M. Microwave drying of ginger (*Zingiber officinale* Roscoe) and its effects on polyphenolic content and atioxidant activity. **Internacional Journal of Food Science and Technology.** v. 47, n. 11, p. 2311-2317, 2012.

PEREIRA, R. C. B.; DA SILVA, A. J. R.; BARBOSA, A. L. S.; SABAA- SRUR, A. U. O. Obtenção de oleo essencial e oleoresina de gengibre (*Zingiber officinale* Roscoe) por arraste com vapor e extração com solvente. **Revista Universidade Rural (série ciências da vida)**. v. 27, n.1, p. 10-20, 2007.