Application Note
No. 269/2017

Lyophilisation of truffles

Lyovapor™ L-200 Pro

1. Introduction

Truffles are products with limited shelf life and their sensory properties are rapidly lost. Hence, the expensive fungi become less valuable within a few days. Losses of volatile compounds, oxidation and enzymatic reactions are a considerable problem during their storage. Furthermore, the aroma profile is commonly modified as a result of elevated temperature processes or enzymatic reactions.
Freeze drying the fungi avoids loss and degradation of volatile compounds due to the low temperatures applied during drying. The aromatic profile of truffles are maintained. Freeze dried truffles can either be rehydrated or directly used in dry form [1, 2].

2. Equipment

- BUCHI Lyovapor™ L-200 Pro
- BUCHI Lyovapor™ Software
- Deep Freezer -24°C
- Stainless steel tray
- Mettler Toledo HR73 halogen moisture analyser

3. Chemicals and Materials

- Fresh summer truffle, purchased from a local supermarket.

4. Experimental

4.1. Sample preparation

The summer truffle was cut into pieces of approximately 1 mm width (Figure 1). The slices were placed on the stainless steel tray and frozen for 24 hours in a deep freezer at -24°C.

Figure 1: Fresh cut truffle slices.

4.2. Lyovapor™ L-200 settings

After 24 hours of deep freezing, the truffle slices were transferred with the tray into the Lyovapor™ L-200 for freeze drying in the cube drying chamber and under ambient air atmosphere.

The shelf temperature itself was chosen such that it does not exceed 20 and 25 °C at the end of the primary and secondary drying (temperature set point), respectively. The steps of the primary and secondary drying process were programmed using the Lyovapor Software as listed in Table 1.

During the primary drying phase the bulk solvent, in this case water, is removed from the sample by sublimation. In the secondary drying phase the sample is dried by removing adsorbed solvent.

Table 1: Parameters of the primary and secondary drying steps, set on the Lyovapor™ Software.

General	Table	Graph		
Step			**1**	**2**
Phase			Primary Drying	Secondary Drying
Time		hh:mm	12:00	12:00
Temperature set point		°C	20.0	25.0
Temperature gradient		°C/min	0.06	0.01
Pressure type			Regulated	Regulated
Pressure set point		mbar	0.370	0.050
Safety pressure		mbar	1.500	1.500
Safety pressure duration		sec	10	10

4.3. Halogen Moisture Analysis

After drying (see Figure 2), the residual moisture content of five truffle slices, were analyzed to assess the drying efficiency. Therefore, the samples were transferred to the moisture analyzer. For moisture analysis, a halogen moisture balance using parameters listed in Table 2 was applied. The switch-off criterion refers to a change of no more than 1 mg / 140 s.

Table 2: Moisture analyser settings

switch-off criterion	5
Drying temperature [C°]	110

Figure 2: Tray with truffle slices after freeze drying.

5. Results and Discussion

5.1. Visual evaluation of the freeze dried truffle slices

Figure 1 and 2 show the truffle slices before and after freeze drying process. All truffle pieces were homogenously dried.

5.2. Moisture analysis of the freeze dried truffle slices

To determine the drying efficiency, the residual moisture content of five truffle slice were analyzed using a halogen moisture analyzer. The results of the measured moisture contents are shown in Table 3.

Table 3: Results of the moisture analysis after freeze drying using the Lyovapor™ L-200.

Truffle piece	Weight of freeze dried sample [g]	Weight of halogen dried sample [g]	Moisture content [%]
1	0.187	0.179	**4.28**
2	0.119	0.115	**3.36**
3	0.165	0.161	**2.42**
4	0.211	0.204	**3.32**
5	0.153	0.147	**3.92**

The analyzed samples contained 3.46 ± 0.63 % moisture after freeze drying process. The initial water content of the summer truffle was 66.33 ± 0.94 % (n=3). Hence, applying the described freeze drying method on the Lyovapor L-200 lead to an average water removal of 94.78 %. With a water removal of approx. 80 %, the freeze dried truffle has a shelf life of more than 24 months [3]. In general, applying the freeze drying process on foods such as truffle slices, have the following advantages and disadvantages [4]:

Advantages

- The process at low temperature and low pressure makes freeze drying an effective way to keep color, smell, flavor and heat-sensitive nutrients of food.
- Eliminates the surface hardening of the food.
- Freeze dried food is porous and easy to rehydrate and/or dissolve. It can be consumed directly or after rehydration.
- Since freeze dried food contains very low moisture, it has relatively small density and is easy to be transported. The freeze dried food can be preserved at room temperature for a long time, while the cost of transportation is much lower than that of frozen food.
- No additives are added into the food during freeze drying process.

Disadvantage

- If exposed directly to air, freeze dried food will be rehydrated quickly, resulting in deterioration of food.
- The freeze dried products have to be vacuum- or vacuum-nitrogen packed and the packaging material must not be permeable to water vapor.
- During transportation and sale process, freeze dried food is easy to be powdered or cracked for its loose porous structure.
- Freeze drying is a time- and energy-consuming process, which leads to higher production costs.

6. Conclusion

Freeze dried truffles are a promising alternative to out of season fresh truffles because flavors, smells and nutritional content remain mostly unchanged in comparison to other drying techniques [1, 3, 5].
With the Lyovapor™ L-200, a high drying efficiency was achieved for the water removal. In summary, the Lyovapor™ L-200 enables to freeze dry fungi samples such as truffle slices.

7. References

[1] I. Palacios, E. Guillamón, A. García-Lafuente, A. Villares; Effects of Freeze drying Treatment on the Aromatic Profile of Tuber spp. Truffles. Journal of Food Processing and Preservation, Volume 38, Issue 3, Pages 768–773, (2014).
[2] http://www.google.com/patents/CN103315048A?cl=en
[3] http://www.tartuflanghe.com/en/tartufo-bianco/dehydrated-white-truffle/
[4] H. Tse-Chao Hua, L. Bao-Lin, Z. Hua; Freeze drying of Pharmaceutical and Food Products, Woodhead Publishing Series in Food Science, Technology and Nutrition, pages 141–169 (2010).
[5] https://www.sialparis.com/Catalogue/Catalogue-Sial-Paris-2016/Products-list/freeze dried-truffles-GEOOFOODS-ITALIAN-TRUFFLES