

INFLUENCE OF FREEZE-DRYING ON THE TEXTURE OF MUSHROOMS

Guiné R.P.F.^{1*}, Barroca M.J.²

¹CI&DETS, Instituto Politécnico de Viseu, ESAV, Portugal.

*Tef: 232 44 66 41; Fax: 232 426 536; raquelguine@esav.ipv.pt

²CERNAS, Instituto Politécnico de Coimbra, ESAC, Portugal.

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Abstract: In the present work the textural properties of mushrooms were studied in the fresh state and after a freeze-drying treatment, to perceive what is the influence of this drying treatment on the texture of the mushrooms. The moisture content was determined in both forms, with the fresh samples showing an average moisture of 90.25 % and the freeze-dried 7.01 % (both wet basis). The texture profile analysis (TPA) to the samples of the fresh and freeze-dried mushrooms that neither possessed measurable adhesiveness, and that hardness decreased very much with drying, either in the cap or in the stalk. Chewiness also varied quite significantly with freeze-drying, contrarily to cohesiveness, which practically stayed the same. Springiness also decreased with drying, although not in a very significant way. When comparing the two parts of the mushroom, it was observed that the cap is much harder, has slightly lower cohesiveness and springiness and a little higher chewiness.

1. INTRODUCTION

Agaricus bisporus, known as button mushroom, is an edible basidiomycete fungus occurring naturally in grasslands, fields and meadows across Europe and North America. Although the original wild form had a brownish cap and dark brown gills, presently the more familiar variant, which it is one of the most widely cultivated mushrooms in the world, has a white form with white cap, stalk and flesh and brown gills.

The preservation of aroma is essential for accessing quality of processed food products, and in particular for the case of mushrooms, which are very much used for culinary preparations because of their unique aroma. Freeze-drying, being a low temperature process, causes less deterioration in the aroma compounds of food products. In this process water is eliminated by sublimation from a frozen state, and the temperature of the product remains very low during the operation [1].

In the present work Texture Profile Analysis (TPA) was performed to fresh and freeze-dried mushrooms, in two parts (cap and stalk), to evaluate the influence of this processing operation in the textural properties of mushrooms.

2. MATERIALS AND METHODS

Button mushrooms, *Agaricus bisporus*, from a local market were selected and washed. The samples were frozen in a conventional kitchen freezer, and then left in the freeze-drier (model Table Top TFD5505, from Uniequip, Germany) for 38 hours at a temperature between - 47 °C and - 50 °C, and a pressure of 5 mTorr (0,666 Pa).

Samples of the fresh and freeze-dried mushrooms were used to calculate the average moisture content, which was measured with a Halogen Moisture Analyser (model HG53, from Mettler Toledo, USA), set to a temperature of 125 °C and a speed 3 (in the range 1 to 5, being 1 fast and 5 slow).

The texture profile analysis to all the samples was performed using a Texture Analyser (model TA.XT.Plus, from Stable Micro Systems, UK), and the textural properties: hardness, springiness, cohesiveness, and chewiness were then calculated after standard equations. Table 1 shows the number of analyses performed to each case.

Table 1 – Number of TPAs performed.

	Cap(Pileus)	Stalk(stipe)
Fresh	4	9
Freeze-dried	5	9

3. RESULTS AND DISCUSSION

Table 2 shows the results of the moisture analysis to the mushrooms in fresh and after freeze-drying. The fresh mushrooms had 90.25 (\pm 1.26) % moisture (wet basis) and the freeze-drying operation reduced the moisture content to 7.01 (\pm 1.24) % (w.b.).

Figure 1 shows the TPAs obtained for the fresh and freeze-dried mushrooms, respectively. It is visible that the hardness of the fresh samples is very much higher than that of the freeze-dried. Moreover, the differences between the cap and the stalk are much more accentuated in the fresh samples than in the freeze-dried ones.

Figure 2 shows the values obtained for the textural properties (adhesiveness, hardness, cohesiveness, springiness and chewiness) from the TPA obtained for the samples of the fresh and freeze-dried mushrooms.

Table 2 – Moisture content of fresh and freeze-dried mushrooms.

Type of mushroom	Sample	Moisture content (%)
Fresh	F1	88,61
	F2	89,91
	F3	91,28
	F4	91,19
	Medium Standard deviation	90,25 1,26
Freeze-dried	L1	5,26
	L2	7,14
	L3	6,15
	L4	8,18
	L5	6,75
	L6	8,55
	Medium Standard deviation	7,01 1,24

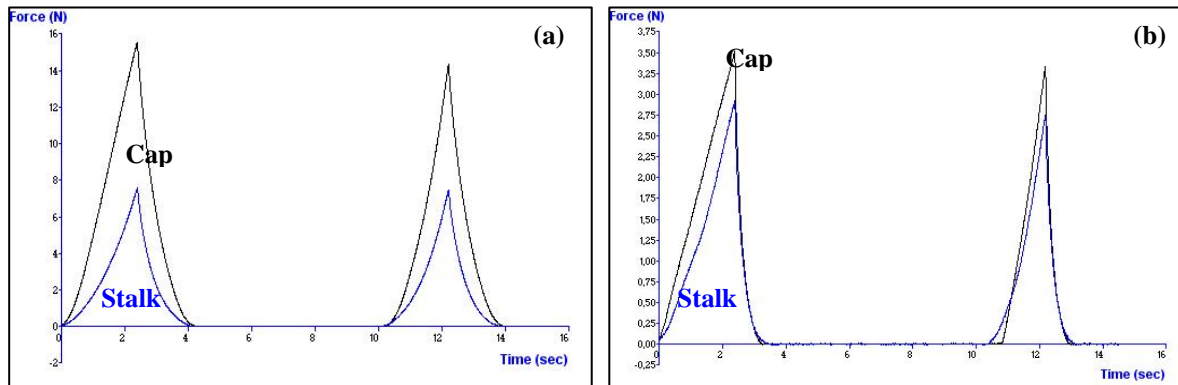


Figure 1 – Texture Profile analysis to the mushrooms: (a) fresh (b) freeze-dried.

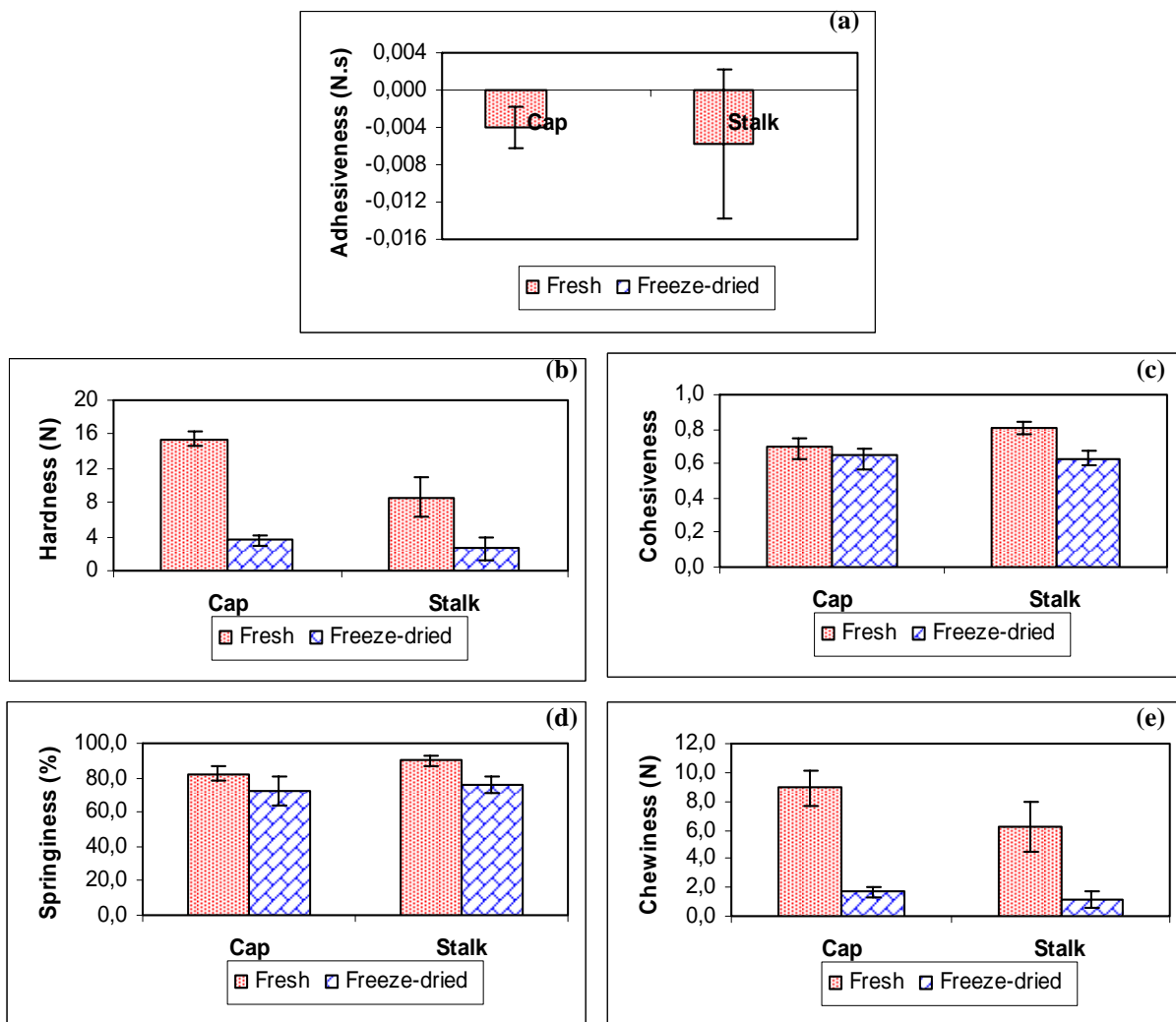


Figure 2 – Textural properties of mushrooms: (a) adhesiveness (b) hardness (c) cohesiveness (d) springiness (e) chewiness.

Figure 2(a) shows that the freeze-dried mushrooms have no measurable adhesiveness and that the fresh ones show a very small value, almost zero, to this property. In figure 2(b) is possible to observe that the hardness is very influenced from the freeze-drying treatment, either for the cap or for the stalk. On the other hand, the cohesiveness (Figure 2(c)) is neither significantly influenced by the drying treatment nor by the position in the mushroom, and the same can be deduced as to springiness (Figure 2(d)). On the contrary, the chewiness (Figure 2(e)) presents a similar pattern to that of the hardness, which is expected since this property results from the product of the hardness by the cohesiveness and by the springiness, and these last two do not change much.

4. CONCLUSIONS

From the present work was possible to conclude that the adhesiveness is practically zero in the fresh mushrooms and indeed zero in the freeze-dried ones. Hardness decreases very much with this treatment, either in the cap or in the stalk. Chewiness is another textural property that varies quite much with freeze-drying, contrarily to Cohesiveness, which practically does not change. Springiness also decreases with drying, although not in a much accentuated way. When the two parts of the mushroom are compared, it is observed that the cap is much harder (almost 2 times harder), has slightly lower cohesiveness and springiness and a little higher chewiness.

References

- [1] Kompany E, René A (1995) Note on the Freeze-drying Conditions for Improved Aroma Retention in Cultivated Mushrooms (*Agaricus bisporus*). LWT, 28, 238-240.