Journal of Thermal Analysis and Calorimetry, Vol. 91 (2008) 1, 47–50

BOUND WATER IS A QUALITY DISCRIMINANT OF DRIED EGG-PASTA

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Egg-pasta is a very popular food in Italy and its appreciation is growing in Europe and in the United States. In this work, the bound water has been demonstrated to be a quality discriminant parameter to distinguish the low-temperature dried egg-pasta with respect to the high-temperature dried egg-pasta. By the thermoanalytical profiles (TG and DTG), this systematic study scientifically proves the differences induced by the drying process on the egg-pasta samples: the low temperature dried egg-pasta (produced by the ‘Entroterra’ company, brand ‘La Pasta di Camerino’) shows the systematic lower amount of bound water when compared to other brand, high-temperature dried egg-pasta. The difference is constant either before or after the cooking process. Other physical parameters (thickness and width) confirmed the difference.

Keywords: *discriminant, DTG, egg pasta, quality, TG, thermal analysis*

Introduction

Egg-pasta is a very popular food in Italy and its appreciation is growing in Europe and in the United States. Starting from very simple ingredients (semolina and eggs), the secret to obtain the best quality is to find the higher quality of the two base-materials (no water is added to the kneading) and the best drying process.

The systematic studies or characterizations of egg-pasta have been published in specialized journals or web sites [1–5] but often are related to only ‘fresh’ egg-pasta. No thermoanalytical data are available.

This study is born from the need of the egg-pasta ‘Entroterra’ producer to scientifically prove the higher quality of his low-temperature dried egg-pasta, with the brand ‘La Pasta di Camerino’, with respect to the high-temperature process usually performed by the bigger industries. This goal is important to justify a slightly higher prize of the low-temperature dried product.

To this end, several samples of both low- and high-temperature dried egg-pasta were investigated by thermogravimetry either before or after the cooking process, to determine quality discriminant parameter(s). The thermoanalytical approach was already applied by our group to determine significant differences in pasta samples [6].

The egg-pasta samples were characterized either before the cooking process at different times (from the day of the package opening up to 20 days after) or after the cooking process. A specific cooking protocol was standardized for the characterization of the cooked pasta to ensure the reproducibility of the results and consequently the rigorous scientific approach.

Bound water revealed to be the discriminant factor to determine the quality of the analyzed egg-pasta samples.

Experimental

Materials

All the analyzed dried egg-pasta samples were collected from commercially available products: three of them (samples A, B and C – brands are omitted) are dried by high-temperature industrial process, while the referring sample (sample D – ‘Entroterra’ producer, with the brand ‘La Pasta di Camerino’) is dried by a low-temperature process.

Thermal analysis

The thermogravimetric curves were obtained using a PerkinElmer TGA7 thermobalance (range 20–1000°C); the atmosphere was air, at a flow rate of 100 mL min^{-1}, to evaluate the behavior in oxidizing conditions; the heating rate was varied between 5 and 40°C min^{-1}, with the best resolution achieved at a scanning rate of 10°C min^{-1}.

Results and discussion

A high percent content of eggs and a good semolina are the basic starting points to obtain egg-pasta of a good quality.

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1388–6150/$20.00

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However, the drying process is the final fundamental step to obtain a quality product: in fact, the right drying process allows the realization of a good structure that will be the insurance of a good taste and a nutritionally good product after the cooking process, like the consumers usually taste the egg-pasta.

To scientifically prove the differences, low- and high-temperature dried egg-pasta samples of different brands, both before- and after-cooking, were investigated by thermogravimetry. The quality discriminant parameter was chosen to be the bound water, since the bound water is not really affected by the cooking process because its amount and binding energy are the direct consequence of the drying process.

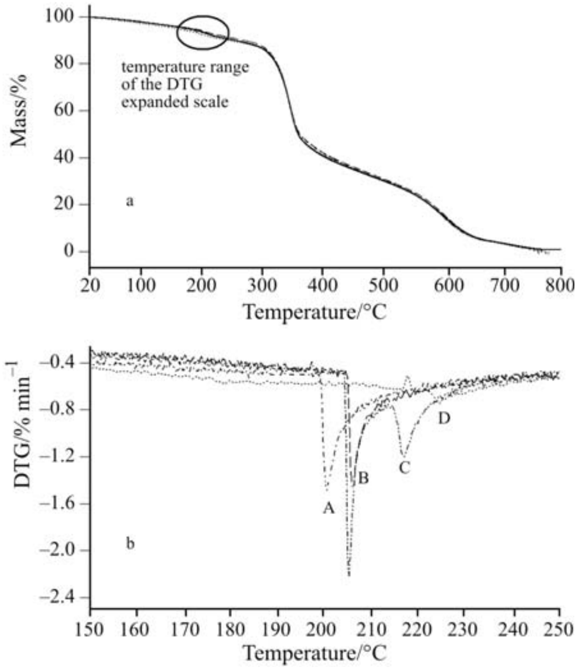

Fig. 1 a – TG profiles of the egg-pasta samples, b – expanded scale (temperature range 150–250°C) of the DTG profiles

Figure 1a shows the thermoanalytical profiles (TG curves) of all the egg-pasta samples analyzed at the 'time zero', the package opening, before the cooking process. By looking at the first derivatives of the TG curves (Fig. 1b – expanded scale: temperature range 150–250°C), it can be clearly seen the higher temperature range needed for the release of the bound water for the low-temperature dried sample (sample D – 'La Pasta di Camerino') with respect to all the other high-temperature dried samples (samples A, B and C). This fact is directly related to the lower thermal stress induced by the drying process on the protein fraction, that allows a stronger gluten structure. This higher stability will have a strong influence in the cooking behavior, as will be shown later.

To check the modifications induced when not all the package content is cooked immediately, the pasta samples were left several days and analyzed at different times. Figure 2 shows the DTG curves of each pasta sample *vs.* time, up to 15 days after the opening of each package. The low-temperature dried sample D 'La Pasta di Camerino' shows a DTG peak that with time becomes sharper but stays at the same temperature, while the other samples dried at higher temperatures show the time-depending shift of the DTG peak. In addition, the sample C also undergoes the vanishing of a DTG peak with time. A possible

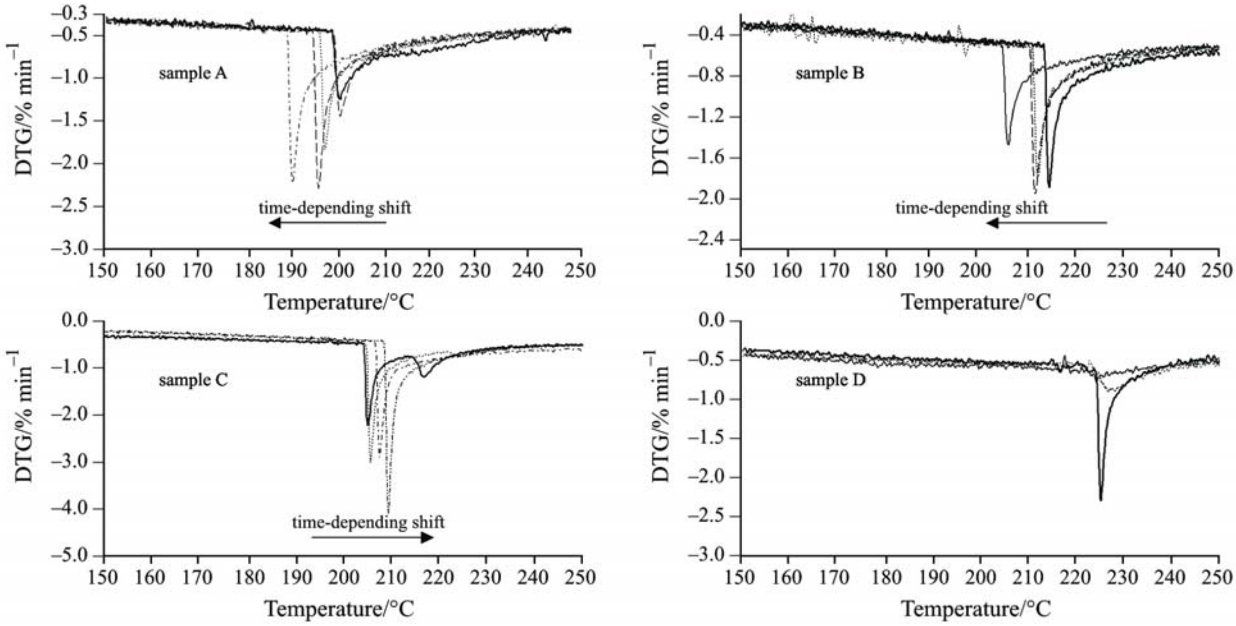

Fig. 2 Expanded scale of the DTG profiles of each egg-pasta sample analyzed as a function of the time after the package opening (up to 15 days)

Table 1 Thickness and width variations of the egg-pasta samples before and after the cooking process, mass loss during the cooking process (residue in the cooking water) and egg % (by the producer)

Sample	Egg/%	Thickness			Width			Loss because of cooking/%
		before/mm	after/mm	Δ/%	before/mm	after/mm	Δ/%	
A (high-T)	23.8	0.9	1.1	22	4.2	5.2	23.8	17.16
B (high-T)	28.3	1.0	1.2	20	5.0	6.2	24.0	18.14
C (high-T)	24.0	1.0	1.2	20	3.0	3.9	30.0	39.77
D (low-T)	33.0	1.0	1.2	20	3.9	1.8	23.0	15.32

explanation of the changes in the samples A, B and C can be the consequence of the drying process that has not been completed because of the shorter time due to the higher temperature. The drying process seems to finish after the package opening.

The different results among the samples at the day 'zero' and several days later can be explained by considering that the structure of the egg-pasta is mainly due to the proteic fraction, so the lower is the stress induced by the drying process, the higher will be the structure strength. When the thermal stability of the bound water is compared to the egg percent content, it becomes clear that a higher amount of eggs (protein fraction, Table 1) results in a higher bound water stability.

After the cooking process, these differences stay the same and are confirmed either by thermogravimetry (Fig. 3) or by physical parameters determined. In Tables 1 and 2 the results for each sample are reported.

To understand better the differences after the cooking process, two main events have to be reminded: *i*) because of the cooking heat, the starch granules absorb water and swell up, with a volume change and *ii*) because of the cooking heat, the proteins all around the starch coagulate, getting stronger the matrix and avoiding the excessive swelling of the starch granules (sticky taste). The two phenomena are in contrast each other, but the final effect is a structural equilibrium that is the base of the final quality. The low-temperature drying process preserves the proteic fraction of the pasta sample and allows a stronger structure that avoid the excessive starch swelling.

Table 2 Water content of each egg-pasta sample after the cooking process

Sample	Bulk water/%	Bound water/%
A (high-T)	48.98	13.72
B (high-T)	40.33	16.75
C (high-T)	41.98	17.42
D (low-T)	45.59	11.27

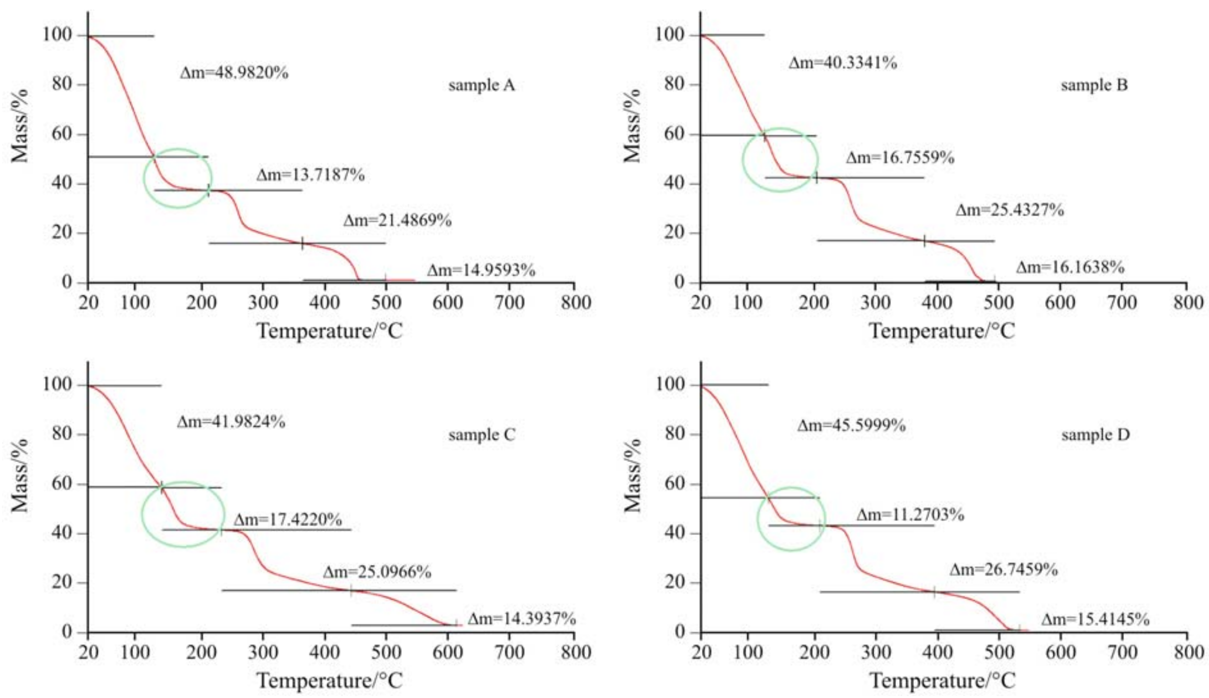

Fig. 3 TG profiles of all the egg-pasta samples after the cooking process

In addition to the thermoanalytical data, other physical data have been recorded and compared: the thickness and the width of each sample either before or after the cooking process, and the residue (loss) in the cooking water (Table 1).

The thickness and the width of each sample pre- and post-cooking prove that the low-temperature dried sample D (brand 'La Pasta di Camerino') absorbs a lower amount of water and so keeps the nutritional and organoleptic characteristics. The sample D also shows a lower residue in the cooking water (lower loss during the cooking process) with respect to the other high-temperature dried samples, due to the higher protein fraction not stressed by the drying process that increase the structure stability.

Conclusions

Thermogravimetry demonstrated to be a valid tool to determine the egg-pasta quality. The bound water can be the discriminant to relate the egg-pasta quality, either before or after the cooking process.

The low-temperature drying process is clearly a better way to obtain the best egg-pasta quality, even if the final cost for the consumer is higher because of both the longer time needed and the higher quality of the starting semolina and egg.

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OnlineFirst: September 17, 2007

DOI: 10.1007/s10973-007-8383-2