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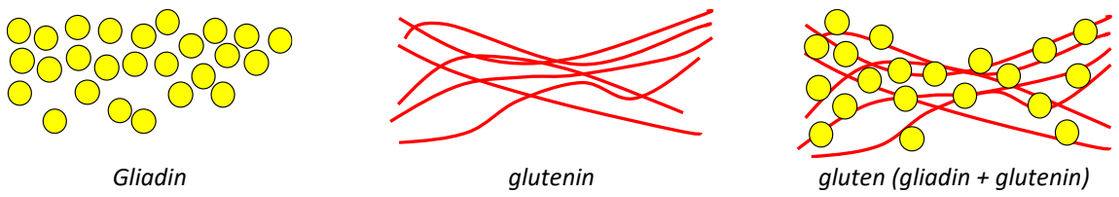
FROM YEASTS TO PROTEINS THROUGH FLOURS

Flour strength and protein structure of gluten

PROTEIN STRUCTURE OF GLUTEN



Gliadin *glutenin* *gluten (gliadin + glutenin)*

Figure 1

In the preparation of bread, the kneading phase of a flour with salt, water and yeasts consists in mixing all the ingredients by hand or using machines, until a homogeneous mixture is obtained. During this processing phase the proteins: *gliadin* and *glutenin*, for the presence of water and the energy supplied, come together giving rise to a plastic and elastic mass called **gluten**.
The three-dimensional structure of gluten presents the protein filaments arranged first in a messy way, then more orderly that form a lattice whose walls together with the water films of which it is covered, give rise to a membrane.

GLUTEN EXTRACTION

The extraction is carried out manually from the faded, with a solution of monosodium phosphate and bi-sodic phosphate prepared in sodium chloride solution. Gluten is, at the end, washed with deionized water to eliminate completely the residual phosphates. The gluten obtained is left in the dryer, at room temperature, for the days necessary to obtain an anhydrous mass and thus to obtain dried gluten. Drying is not carried out into the stove to avoid any possible alteration of gluten caused by heating. Once dried it appears amber in color and crystalline structure. Dried gluten is used to record IR spectra using the ATR method and they are processed by means of the deconvolution method of the *amide I* band. This is a characteristic band of proteins.

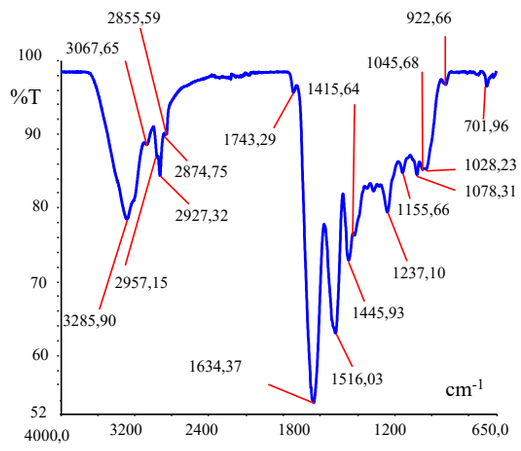


figure 2

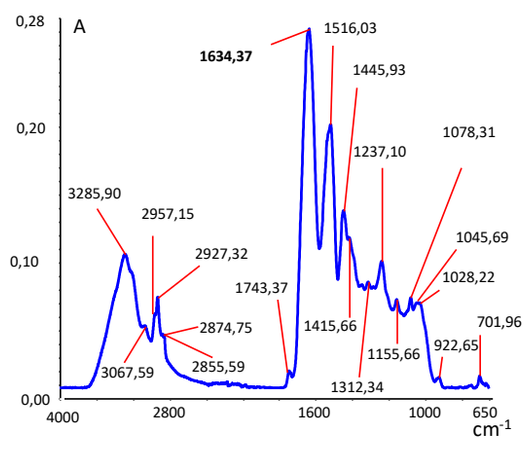


figure 3

The figure 2 and figure 3 show, respectively, the transmittance (T%) spectrum and the absorbance (A) spectrum of naturally dried **gt0 gluten** (flour type 0 of organic common wheat).

The following tables show the vibrations and their frequencies of the amide group of gluten.

$\bar{\upsilon}$ (cm^{-1})	3285,90 (A=3300)	3067,65 (B=3110)	2957,15 (2972—2953)	2927,32 (2936—2916)
Assignment	Stretching of the N—H group in resonance with the over-tone 2xamide II	N—H stretching of the amide group.	asym. stretching of the C—H in the $—CH_3$ group.	asym. Stretching of the C—H in the $>CH_2$ group.

Table [Gluten gt0]

Continuation of the previous table

$\bar{\upsilon}$ (cm^{-1})	2874,75 (2882—2862)	2855,59 (2863—2843)	**1634,37** (1680—1630 (amide I)	**1516,03** (1570—1515)
Assignment	sym. stretching of the C-H in the $—CH_3$	sym. stretching of the C—H in the $>CH_2$	stretching of the **C=O** in the secondary amide (*amide I*)	deformation of the **N—H** in the secondary amide (*amide II*)

Table [Gluten gt0]

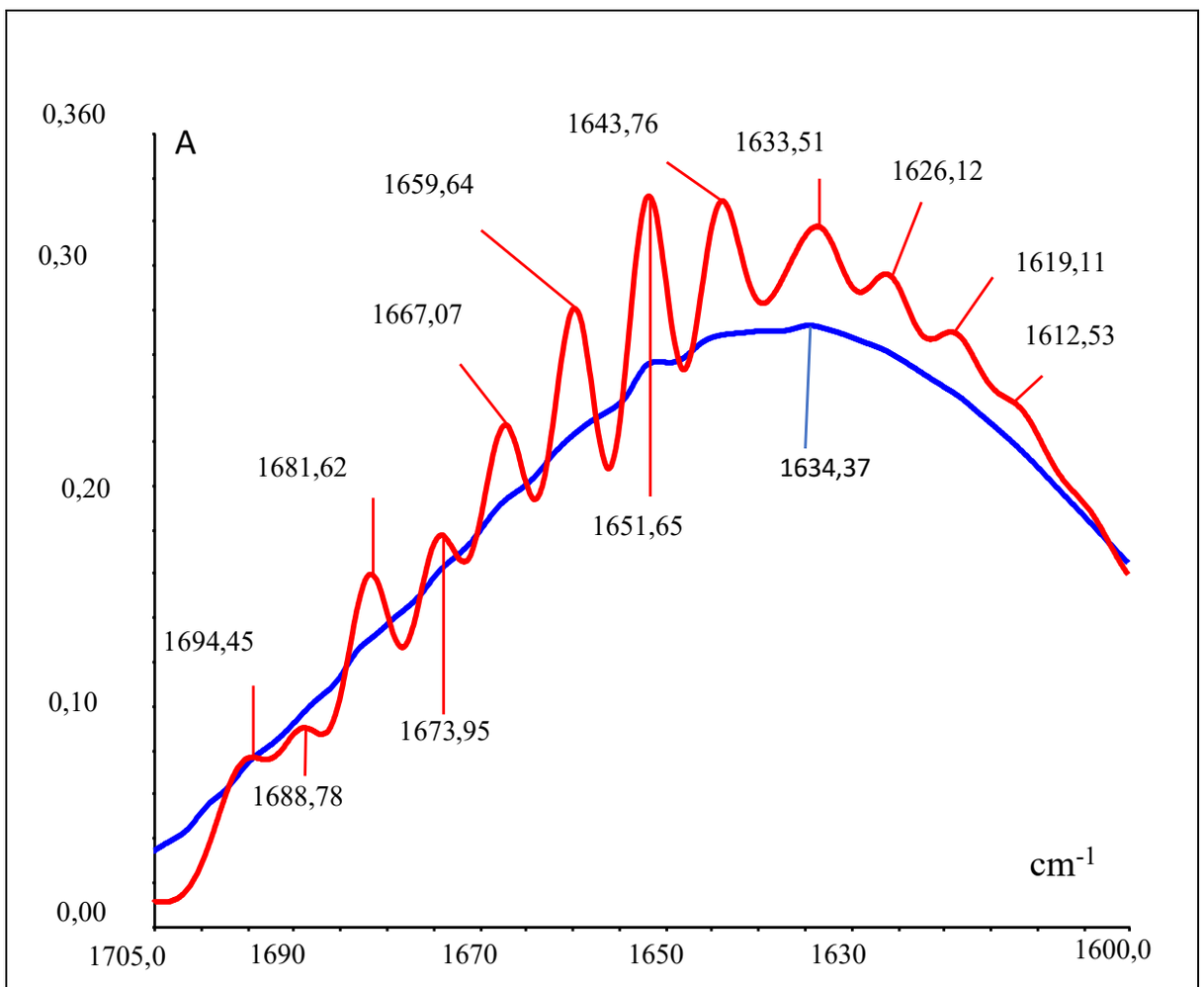
Continuation of the previous table

$\bar{\upsilon}$ (cm^{-1})	1445,93 (1470—1430)	1415,64 (1420—1410)	1237,10	922,68	701,90 (720—725)
Assignment	C—H deformation of the $—CH_3$ group. [asym. bending]	C—H deformation of the $—CH_2—CO-$	—	—	skeleton $—(CH_2)$ n-

Table [Gluten gt0]

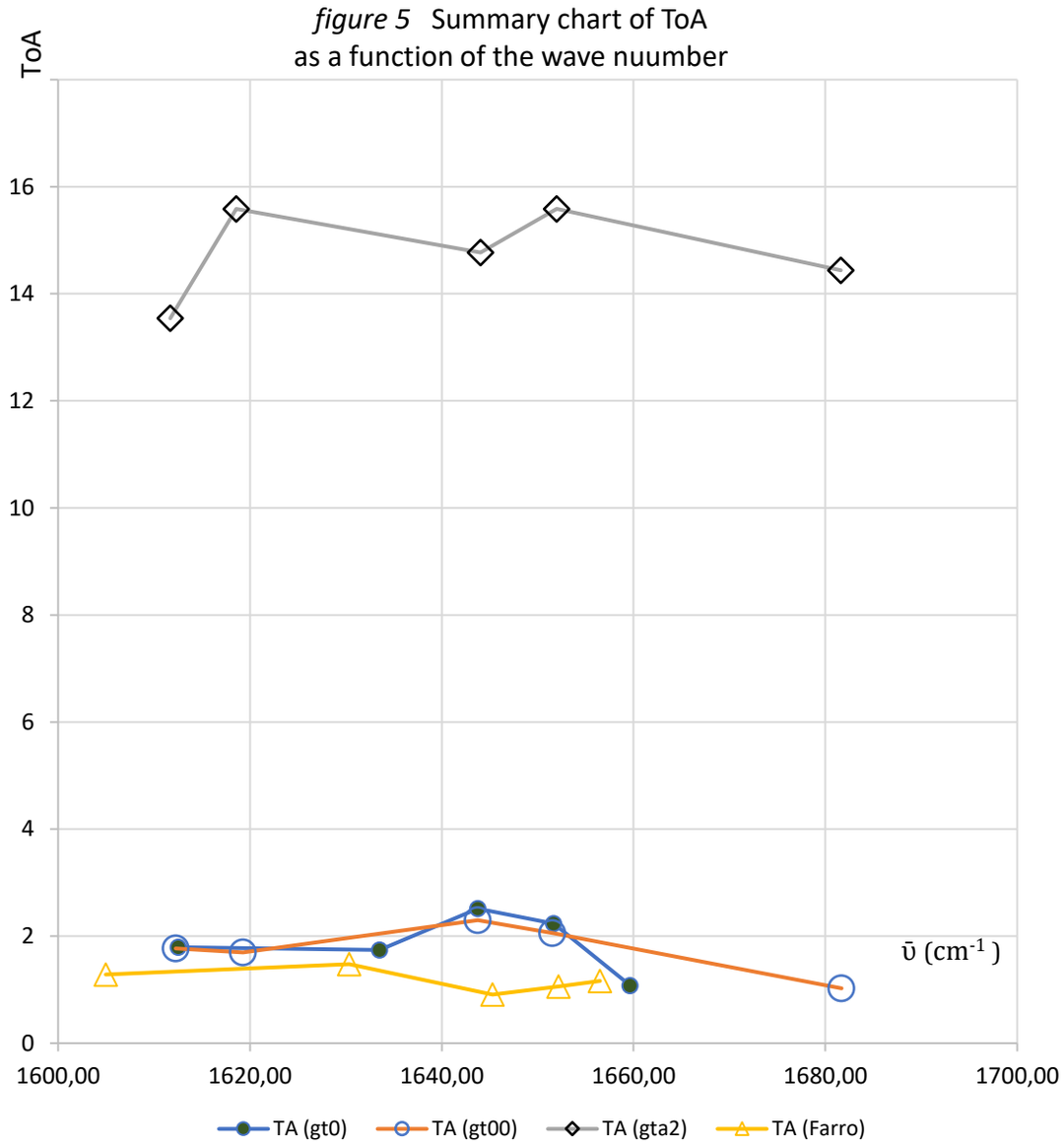
DECONVOLUTION. Two parameters must be fixed to carry out this processing: the *gamma* parameter is used to dissect the spectrum in intervals of wavenumber. The other is *smoothing* parameter. It smooths the spectral curve within the mentioned intervals.
The processing of the spectrum in figure 4 consists of the structural analysis of the band amide I (1634,37) by means of the deconvolution operation which, as explained above, requests to fix the two parameters called gamma and smoothing.
In this case the values used, are gamma = 2,8 and smoothing = 65%

figure 4



Gluten **gt0**: medium spectrum (blue curve) of seven spectra and de-convoluted spectrum (red curve)
Bands that appear as a red curve are used to calculate the area underlying them, and from this area, the percentage composition of each configuration (T, α, β, R, S) is calculated.

figure 5 Summary chart of ToA as a function of the wave nuumber



To make the summary chart, the Excel program is used and the variables ῡ (cm^{-1}) and the value of the ToA area [calculated from the de-convoluted spectrum] are chosen. If multiple bands represent the same configuration of those possible (T, α, β, R, S), it is necessary to use the highest value of the ToA.

DISCUSSION

Gluten of different flours sometimes exhibits remarkably similar behaviors as for the flours type gt0 and gt00. In the graph the two broken lines, in fact, are almost overlapping throughout the range. Spelt has, in the first part, a behavior similar to the other two but differs, from these, in the range of wave numbers from about 1630 to about 1660 cm^{-1}. Other flours have a completely different gluten from the previous ones: in particular, the gluten of the ancient common wheat, type 2. The broken line that represents the latter is much higher in the graph than the other three lines. It means that this type of wheat has quite different properties compared to the most modern wheat.

CONCLUSIONS

This research highlighted that an accurate and thorough scientific study of gluten, using infrared spectroscopy, allows us to introduce of a new method of characterization and differentiation of the flours that contain it. In addition, it could be used to know the origin of flours.

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