

## Organic Vs Conventional Winter Wheat Quality and Organoleptic Bread Test

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### Abstract

*In the frame of a long-term experiment carried out in Central Italy, conventional and organic winter wheat cropping systems were compared in 2004 and 2005 to evaluate the effect of system management on wheat grain yield and quality. The organic system showed grain and straw yield about 50% lower than the conventional system. Organic grain samples resulted 20% lower in protein content and exhibited poor bread production qualities. Despite that, organic bread, did not show differences in crust thickness, crumb volume and in crumb alveolus structure in a visual evaluation. Differences were, however, appreciated by panellists who found organic bread harder and more flavourful than conventional.*

### Introduction

A clear understanding of the relationships between farming systems and crop nutritional quality is very important for designing agricultural management strategies which enhance environmental quality and sustainability while improving consumers health. Agricultural production systems may differ greatly in terms of amount and sources of fertilisers, crop protection strategies and crop rotation. As such, a relationship between food quality and farming systems could be expected. Moreover the concept of quality is not only strictly related to food nutritional composition but it is often associated with the taste and more generally with the sensory properties. The aim of this study within the framework of the MASCOT long-term experiment (Bärberi and Mazzoncini, 2006) was to evaluate the effects of conventional vs organic cultivation on winter wheat grain quality in the years 2004 and 2005 and to give the preliminary results of an informal organoleptic satisfaction test on bread derived from the same wheat variety.

### Materials and methods

The MASCOT experiment (Mediterranean Arable Systems COmparison Trial) was established in 2001 at the Interdepartmental Centre for Agro-Environmental Research "Enrico Avanzi" (CIRAA) of the University of Pisa, Italy. Winter wheat was cultivated in this experiment as a part of a five-year stockless arable crop rotation comparing a conventional and an organic management system. Different nitrogen rates mark the wheat fertilization of two cropping systems: the organic receives an organic fertilizer at the rate of 30 N units per ha, while the conventional is fertilized at a rate of 160 N units per ha using chemical fertilizers. The following quality analyses were performed on grain samples from conventional and organic grown winter wheat (cv *Bolero*) in 2004 and 2005: hectolitre weight, 1000 seed weight, protein content (N x 5.7), SDS (Sodium Dodecylsulphate Sedimentation), gluten index, total phenols and bread production

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qualities of the flour such as P (resistance to stretching), L (extensibility) and W (strength) were also taken into account. Wheat flour was obtained by stone milling the grain in a water driven mill and then sifting it through sieves, separating out only a part of the seed coats and not eliminating the germ. Bread loafs were baked in two commercial bakeries. Tests on bread loafs were performed twice by semi-trained panellists (CIRAA staff -Test N°1: 44 people) and customers of a commercial bakery (Test N°2: 157 people average age 51). Tests included preference and organoleptic analyses related to flavour, fragrance, crust and crumb consistency. Uniform sized samples were pre-coded and presented to the panellists; clean water was provided to the panellists to rinse their mouths between samples tasting. An evaluation form was provided to each panellist to record his or her judgement. The following characteristics were evaluated in Test 1: crust consistency (crisp, intermediate, hard); crumb consistency (soft, firm, hard); flavour (tasty, acceptable, unpleasant); fragrance (pleasant, neutral, unpleasant); overall evaluation (excellent, good, acceptable, poor). In Test 2 panellists were asked to answer to the following questions: "Which bread do you prefer?" and "Why do you prefer it?" (flavour, flavour and consistency, consistency, uncertain).

### Results and discussion

Organic wheat showed a grain and a straw yield about 50% lower than conventional system wheat, while 1000 seed weight and hectolitre weight were not affected by cropping systems (table 1).

**Tab. 1: Conventional and organic wheat yield characteristics**

	Grain yield (t DM/ha)	Straw yield (t DM/ha)	1000 seed weight (g)	Hectolitre weight (kg)
<b>2004</b>				
Conventional	5.46	6.36	30.9	78.8
Organic	2.38	2.35	34.1	76.4
	*	*	n.s.	n.s.
<b>2005</b>				
Conventional	5.69	6.47	35.1	82.8
Organic	2.57	2.80	33.9	80.7
	*	*	n.s.	n.s.

\* significant for  $P < 0.05$

Protein content was about 20% lower in the organic wheat samples (table 2). As was expected, bread production qualities were strongly affected by cropping systems: organic wheat showed lower values in terms of strength (W) which could lead to less than optimal increase in bread volume. In contrast, the P/L values for conventional wheat flour are lower, which tend to indicate softer dough and bread. There is a strong linear association between protein content on one hand and the SDS (measuring gluten strength) and W indices on the other hand, i.e., an increase of protein leads to an increase of W and SDS as noticed by Ambrogio et Janbzadeh (1987). The gluten index is correlated to the strength and elasticity of gluten and not strictly dependent on protein content. Gluten quality, which is expressed by the gluten index, seemed to indicate a slight superiority in the conventional system in 2004, while in 2005, no differences between the two systems were detected. This result is in accordance with Carcea (2002) whose findings indicated no influence by cropping system on this index.

**Tab. 2: Chemical and bread production characteristics of wheat grain**

	Protein content (% dm)	Total Phenols GE mg/g	Ash (% dm)	Gluten index (%)	SDS (ml)	W (J 10 <sup>-4</sup> )	P/L index
<b>2004</b>							
Conventional	14.6	0.50	1.64	99.3	69.3	117	0.29
Organic	11.4	0.44	1.71	97.3	54.0	82	0.84
	*	n.s.	n.s.	**	n.s.	*	*
<b>2005</b>							
Conventional	13.3	0.53	1.78	80.1	51.0	145	0.48
Organic	10.3	0.49	1.84	83.6	30.0	49	0.85
	*	n.s.	ns	n.s.	n.s.	*	*

\* significant for  $P < 0.05$

Table 3 reports the chemical characteristics of the milling products: flour and bran. Nitrogen content was slightly, but significantly, higher in conventional flour and bran samples than in organic ones. Phosphorous content was higher in conventional bran but was lower in conventional flour. As regards phenol content, organic bran showed a 20% higher, but not significant, accumulation in the external parts of the seed represented by bran; differences detected between the two cropping systems were less evident in the flour. This seems in agreement with early findings (Zhou et al, 2004) that reported bran (especially the aleurone fraction) as having the greatest total phenol content. Moreover Carcea (2002) reported higher phenolic acid content in organic wheat grain.

**Tab. 3: Qualitative characteristics of bran and flour after grain milling in 2005**

	bran			flour		
	N (%)	P (%)	Phenols (ppm)	N (%)	P (%)	Phenols (ppm)
Conventional	2.9	1.11	1678	1.8	0.12	420
Organic	2.4	1.03	2017	1.3	0.15	444
	*	*	n.s.	*	*	n.s.

\* significant for  $P < 0.05$

Despite organic and conventional grain samples showing the above mentioned differences in protein content and bread production qualities, a visual evaluation of bread did not reveal differences in the crust thickness, crumb volume and in the alveolus structure of the crumb. Bakers noted a lower strength in the organic flour when kneading the bread dough.

**Results of Test N°1** - 27% and 73% of the panellists savoured conventional and organic bread respectively. Conventional bread appeared to be characterized by having a crisp crust (54%), a soft crumb (72%), an acceptable flavour (56%) and a pleasant (60%) fragrance. 60% of the panellists gave it an overall evaluation of good and 40%, acceptable (table 4). The crust of organic bread was judged crisp by 41% of the panellists and the crumb as firm by 45%. Most panellists found it tasty (91%) and pleasantly fragrant (74%). Most panellists gave it a good overall evaluation (55%), but all the other overall evaluation values were given too (19% excellent, 16% acceptable, 10% poor). It should be pointed out that 36% of the panellists found that organic bread had a hard crust and 19% a hard crumb, while only few people expressed these opinions about conventional flour bread. About 90% of the panellists preferring organic

bread found it tasty, referring to an “old- time”, “a grassy” or a “more authentic” flavour.

**Tab. 4: Test 1- Panellists overall bread evaluation (%)**

	Overall evaluation			
	excellent	good	acceptable	poor
Conventional	-	60	40	-
Organic	19	55	16	10

*Results of Test N°2* - Organic bread was preferred both by the women (61%) and the men (57%) who were interviewed; 6% of women and 12% of men did not express any preference. Customers who chose organic bread stated that they preferred it (table 5) for its flavour (40%), flavour and consistency (34%), consistency (16%) and 10% were uncertain.

In both tests, flavour more than other characteristics seemed to have a strong influence in guiding the customer preferences

**Tab. 5: Test 2- Panellists answers (%) to the question: Why do you prefer the bread you chose?**

	Flavour	Flavour and consistency	Consistency	Uncertain
Conventional bread	43	24	25	8
Organic bread	40	34	16	10

## Conclusions

The conventional cropping system seems to determine better performance than organic in terms of grain yield, seed protein content and flour bread production qualities. The organic system seems to positively affect flour and bran phenol content. Conventional flour produced “soft” bread while organic flour produced bread that was judged slightly hard and more flavourful.

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## References

- Ambrogio E., Jenabzadeh P. (1987): Il test di microsedimentazione in SDS nell'analisi della qualità del grano tenero. *Tecnica Molitoria*. aprile:273-277.
- Barberi P., Mazzoncini M. (2006): The Mascot ( Mediterranean Arable Systems Comparison Trial) long-term experiment (Pisa, Italy). In Long-term Field experiments in Organic Farming. *Isobar. Sci.Series N°1*, p.1-15.
- Carcea M. (2002):Valutazione dell'impatto Valutazione dell'impatto delle tecniche di produzione sulla qualità tecnologica e nutrizionale di prodotti biologici della filiera dei cereali. In: *Rapporto sul Progetto finalizzato MIPAF: Determinanti di qualità dei prodotti dell'agricoltura biologica*. Bologna 14 settembre 2002, p.44-58.
- Zhou K., Lan S., Liangli Y. (2004): Phytochemicals and Antioxidant Properties in Wheat Bran. *J. Agric. Food Chem.* 52:6108-6114

