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Valorization of the honeys from the Molise region through physico-chemical, organoleptic and nutritional assessment

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Physico-chemical and organoleptic assessment of 55 honey samples and the honey nutritional information and labelling are reported in order to highlight the merits of honey produced in the Molise region.

Data showed that all the samples' analytical parameters were in conformity with the limits set by the Italian legal regulations.

The high values of coefficient of variation for HMF, diastase activity and total acidity indicated that there were qualitative differences in the samples due to the non uniform distribution of the correct beekeeping techniques in the region. Interesting relationships were found between some of the parameters analysed.

In addition, an example of nutritional information and labelling in conformity with the EEC regulation is provided. Copyright © 1996 Elsevier Science Ltd

INTRODUCTION

Honey, with its high glucose and fructose content, is a source of energy that is instantly usable. The fructose content (monosaccharides that the human body uses without recourse to insulin) (Henry & Crapo, 1991), traces of nutritional substances (mineral salts, proteins, organic acids and vitamins), and the genuineness of the raw, unrefined product accounts for its traditional use as a sweetener and also its suitability for diabetics, athletes and elderly people.

In the last 5 years, honey production in Italy is around 11,000 t, barely 50% of the national requirement. The same is true for honey consumption, mean intake in the last 3 years is more or less set at 0.35 Kg pro capita. These figures, when compared with other European partners, are among the lowest and are certainly far removed from the approximately 1.2 Kg pro capita in Germany and Greece (FAI, 1995).

There is therefore plenty of scope for increasing production and being an unsaturated market where this product is receiving growing interest because of its particular qualities, the prospects of marketing honey in Italy are promising.

In fact, there is an increase in the demand for agro-food products having particular chemical and/or organoleptic characteristics that are determined by the production technologies used and/or the geographic origin.

Since variations in chemical composition depend on the type of honey, production area (Perez-Arquillué *et al.*, 1994, 1995), nectar and manufacturing processes, the characteristics of the honeys produced in different orographic areas of the Molise have been studied.

The Molise is a small Italian region where due its complex relief, diverse climatic conditions and low population, high quality honey (mainly multifloral), having particular organoleptic characteristics, can be produced.

The work can contribute in the valorization of the honeys produced in the Molise region:

1. physico-chemical and organoleptic assessment of actual production in order to identify and solve the critical points regarding the entire production process;
2. provide proper nutritional information on the use of honey and an appropriate nutritional labelling so that consumers are well disposed towards this product.

MATERIALS AND METHODS

The study was carried out on 55 honey samples produced in 1993–1994 in the Molise. A stratified sampling

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Table 1. Physico-chemical and organoleptic characteristics of 55 honey samples

Parameter	Mean	Range	SD	CV	Reference Values[a] Mean	Italian Law[b] Limit
Water (%)	16.3	15.1–18.3	0.73	4.5	17.2	≤ 21
HMF (mg/Kg)	7.8	0.8–25.3	4.65	60.0	5.2	≤ 40
Diastase activity (G°)	39.1	17.0–84.0	13.28	34.0	18.9	≥ 8
Ash (%)	0.10	0.03–0.39	0.07	65.7	0.33	≤0.6
Total acidity (meq/Kg)	25.8	12.3–36.8	5.95	23.0	24.4	≤ 40
pH	3.50	3.05–4.50	0.27	7.7	—	—
Fructose (%)	40.6	33.2–46.5	3.30	8.1	39.8	—
Glucose (%)	33.5	27.5–45.3	2.87	8.6	29.2	—
Sucrose (%)	1.09	0.0–4.7	1.09	100.8	1.1	≤ 5
Glucose + Fructose	74.1	62.6–82.0	4.15	5.6	69.0	—
Fructose/Glucose	1.21	0.98–1.46	0.12	10.0	1.36	—
Glucose/Water	2.06	1.66–2.60	0.18	8.6	1.70	—
Organoleptic judgement	6.8	5–8	0.77	11.4	—	—

[a]Accorti *et al.* (1986).
[b]Republica Italiana (1982).

was made as regards the geographical distribution of the beehives. A card recording data on the producer and bee-keeping company provided both an updated picture of the sector and a historical background of each sample. The declared botanical origin of the honeys was 75% multifloral, characterized by the following predominant species: *Hedysarum coronarium, Helianthus annuus, Onobrychis viciifolia, Medicago sativa, Robinia pseudoacacia, Trifolium repens* and *Trifolium pratense*. Each sample was divided into 2 groups, the first was analysed at the time of sampling, the second group was stored at -20°C for later analyses.

Moisture, ash, hydroxymethilfurfural (HMF), diastase activity, pH and total acidity were determined according to the official methods for honey analysis (Repubblica Italiana, 1984).

The fructose, glucose and sucrose sugars were determined using an HPLC chromatographic method (AOAC, 1990). The system consisted of a Waters HPLC with model 600E solvents delivery system, a 410 Differential Refractometer detector and a Rheodyne 7125 injector. A Waters carbohydrate analysis column (3.9mm × 300mm) at 30°C was used: the mobile phase consisted of an acetonitrile:water 80:20 v:v at a flow rate 0.8mL/min. The refractometer's operating parameters were set at scale factor 20, sensitivity 4.

Sensorial analysis was carried out by the Gonnet & Vache (1984) method. The visual, olfactory and taste aspects together with a global assessment on a scale from 1 to 5: excellent, good, satisfactory, mediocre and poor, were recorded on a card.

RESULTS AND DISCUSSION

The results of the physico-chemical analyses and the global assessment of the organoleptic assessment given in Table 1 include the arithmetic average, minimum and maximum values, the coefficient of variation and the limits set by the legal regulations in Italy (Repubblica Italiana, 1982).

Data showed that all the samples' analytical parameters were in conformity with the limits set by the Italian legal regulations. Diastase activity was high and HMF values were very low, indicating the high degree of freshness of these honeys. Total acidity was within the limits (below 40 meq/Kg), indicating the absence of undesirable fermentations. In three samples, glucose + fructose content (HPLC determination) was slightly below the 65% limit set for reducing sugars (Fehling method). In addition, the classification of the honeys, based on the botanical predominance indicated by the apiculturists, did not correspond, from a chemical viewpoint, to the values recorded on the characterisation tables of different unifloral honeys (Accorti *et al.*, 1986), especially those for glucose and fructose and their ratio which indicates that these honeys did not have strong unifloral characteristics but belonged to the multifloral category.

The high values of the coefficient of variation (CV) of the HMF, diastase activity and, to a lesser extent, of the total acidity indicate that there are qualitative differ-

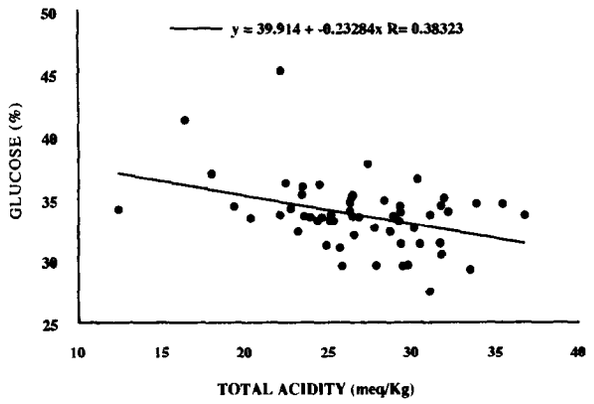

Fig. 1. Linear regression between glucose and total acidity in 55 honey samples produced in the Molise.

ences in the samples due to the non uniform distribution of the beekeeping techniques in the region. Therefore, with a view to the correct preservation and exploitation of honeys in the Molise, the first steps that should be taken are the review and standardisation of quality. However, the considerable variability in sucrose and ash content (parameters mainly linked to the honey's origin), indicate a high variability in the botanical and geographical origin of the samples. These are interesting aspects when considering the production of a wide range of honey types.

Relations were found between some parameters analysed, such as the inverse correlation ($r=-0.383$, $P\leq0.05$) between glucose and acidity (Fig. 1), probably caused by the enzymatic oxidation of glucose into gluconic acid, the main component of organic acids in honey. Figure 2 shows the correlation between pH and ash ($r=0.755$, $P\leq0.0001$), that could be attributed to the high cationic content, particularly K (Leuzzi & Mincione, 1991; Rodriguez-Otero *et al.*, 1994), that may influence the salinized fraction of the acids.

Further correlations were found between the organoleptic assessment and ash ($r=-0.381$, $P\leq0.05$) and the organoleptic assessment and fructose/glucose ($r=0.405$, $P\leq0.01$). A high fructose content as opposed to glucose slows down crystallisation, thus confirming the general preference for honeys having a liquid consistency or fine crystallisation.

From a sensorial point of view, the samples were in a uniform liquid state with slight crystallisation in some cases, but none had separated into two phases nor had air bubbles.

All the samples were yellow-coloured and the differences in shades of yellow, apart from a few exceptions, were due to their botanical origin (oak and/or chestnut honeydew). The taste and olfactory analyses showed that most samples had a light fruity taste and a certain aromatic note due to the presence of alfalfa plants.

In addition, the organoleptic assessment was found to be a valid diagnostic method as it enabled the identification of botanical predominances the beekeepers had not stated. As regards unifloral honeys, their botanical predominance were confirmed only in 2 cases (sunflower and oak honeydew).

The second part of the study regards an in-depth examination of the nutritional aspects in order to suggest correct nutritional information and labelling for honeys.

It is apparent from the chemical composition of honey (Table 2), that its nutritional value lies in high glucose and fructose content which, as they are completely used by the metabolism, make it a valid source of energy. Recent research on the metabolic effects of simple sugars have shown that there is no direct relation between their intake and the onset of cardiovascular diseases, essential hypertension, diabetes mellitus and abnormal behaviour. Moreover, an intake of sugars (except those from milk and those incorporated in food cell structures) of up to 30% calorie intake does not constitute a metabolic risk for normal subjects. Therefore, an average intake of 60 g/day or 10% total calorie intake has been proposed (Report of Sugars Task Force, 1986; DH RHSS 41, 1991). Honey is recommended at breakfast time when the main calorie intake should be glucides so as to satisfy the appetite after the physiologic overnight fasting. Simple glucides are essential at breakfast because they are absorbed rapidly and can constitute, according to the recommendations of nutritionists, up to 20% energy intake (Magnati *et al.*, 1994). Honey, whether refined or raw, is recommended as a sucrose substitute because, although it provides the same energy, it is a stronger sweetener and produces lower hematic levels of glucose and insulin since it contains a large amount of fructose (Henry & Crapo, 1991) besides having particular organoleptic characteristics. It also contains potassium and vitamins that, for the quantities of honey eaten, are nutritionally negligible.

The nutritional information and labelling for honey in conformity with EEC (1990) regulation are suggested in Table 3 together with a breakfast example for a

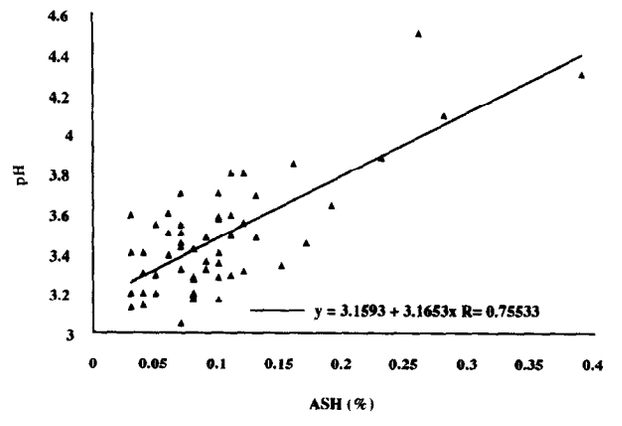

Fig. 2. Linear regression between pH and ash in 55 honey samples produced in the Molise.

Table 2. Chemical composition and energy value of honey[a]

	Mean	Range
Water (g)	18.6	17.5–20.6
Protein (g)	0.38	0.3–0.5
Fat	0	0
Fructose (g)	38.8	35.9–42.1
Glucose (g)	33.9	26.3–39.8
Sucrose (g)	2.4	1.7–3.0
Iron (mg)	1.3	0.9–2.0
Copper (μg)	90.0	—
Calcium (mg)	4.5	3.6–5.0
Phosphorus (mg)	18.0	16.0–20.0
Potassium (mg)	47.0	43.0–50.0
Vitamin B1 (μg)	3.0	2.0–4.0
Vitamin B2 (μg)	50.0	20.0–100.0
Nicotinamide (μg)	130.0	100–200
Energy value	302kcal / 1263kJ	

[a]Souci, *et al.* (1990).

Table 3. Nutritional information and labelling for honey

Nutritional information

Honey is recommended at breakfast time when the main calorie intake should be glucides so as to satisfy the appetite after the physiologic overnight fasting. Simple glucides are essential at breakfast because they are absorbed rapidly and can constitute, according to the recommendations of nutritionists, up to 20% energy intake.

Nutritional labelling

	100 g	20 g (2 teaspoons)	Breakfast[a]
Energy value	302 kcal–1263 kJ	60 kcal–252 kJ	526 kcal–2201 kJ
Protein	0.4 g	0.1 g	15 g
Carbohydrate	75.2 g	15.0 g	76 g
Sugar	75.2 g	15.0 g	26 g
Starch	0 g	0 g	50 g
Fat	0 g	0 g	18 g

[a]Milk (3.5% fat) 240 ml, honey 20 g, bread 100 g, butter 10 g, according to the breakfast recommendations for adult men (75 kg, 11.5 MJ) with light lifestyle activity level.

moderately active adult man (75 kg, 11.5 MJ, 2,750 Kcal) who follows a nutritionally correct diet (30% energy intake derived from lipids, 12% from proteins and the rest from carbohydrates) (Scientific Committee for Food, 1993). This shows that with a 10–20 g daily intake of honey, in line with nutritional recommendations, the consumption pro capita could significantly be increased in many countries.

CONCLUSION

The analytical results on the honeys produced in the Molise in 1993–1994, indicate a good level of quality both as regards the marketable and organoleptic aspects. The parameters indicating the degree of freshness and shelf life of the product were most satisfactory. However, a rationalisation and standardisation of beekeeping techniques throughout the Molise region could further improve and ensure quality over the years. These considerations together with a correct nutritional information and labelling of the product are essential for a proper exploitation of the honey in the Molise region.

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