POLLEN IN HUMAN NUTRITION

M. ABREU
CUBA

The beneficial nutritional effects of pollen have been adequately discussed; little study has however been conducted for describing its characteristic features on the basis of a large range of tests.

In Cuba pollen production is low as yet, but it is a tropical country with rich flower sources and immense possibilities to increase production within a relatively near future.

It was therefore decided to conduct a nutritional and toxicological study of a mixed flower pollen sample from the Beekeeping Unit of the Ministry of Agriculture of Cuba.

The investigations included both chemical analysis and bioassays.

Chemical analysis consisted of identification of components of nutritional macroelements (HORWITZ, 1975), dietetic fibre (NAVARRO, 1988), aminoacids (PELLET, 1980), fatty acids (METCALF, 1966) and of minerals (HORWITZ, 1975). In addition, investigations have been also made for identifying toxic or antinutritional substances which would frequently occur in plant products such as alkaloids (MACKED, 1972), saponins (RONDINA, 1969), cyan group (BURRIEL, 1968), lectins (JAFFE, 1972), inhibitors of trypsin (KAKADE, 1969), polyphenols (DEB CHOUDHURY, 1983), and phytic acid (OBERLEAS, 1971).

Bioassays were made on rats in order to determine the quality of proteins (PELLET, 1980) with evaluation of their real digestibility and biological value.

Also, the innocuous effect of pollen was determined by a sub-chronic toxicity bioassay (PAG/UNU, 1983). For three months, a test group of rats was fed with pollen alone, while another test group of rats was fed with pollen as the source of 50% of proteins, and with casein for the rest of 50% of proteins. At the end of the bioassay period hematological, biochemical (in serum and urine), histopathological, histochemical and enzyme tests were made. The control group was fed on casein alone.

Results and discussion

The composition of the mixture of flower pollens is given in Table 1. The results are within the usual range of figures reported in the technical literature. The fat content was however relatively high. In samples of mixed flower pollen taken in other places the fat content was of up to 39%. On the other hand, it is assessed that pollen is a

good source of dietetic fibre, a food constituent of plant origin of utmost importance in preventing colon cancer, diverticulitis, diabetes, obesity, ischemic cardiopathy, constipation, and other diseases (CUMMINGS, 1990).

Table 1

Nutritive constituents of pollen

Tests	g/100 g
Moisture	10.0
Fats	17.5
Proteins (N. 6.25)	22.0
Ash	3.1
Crude fibre	6.6
Dietetic fibre	19.4

Table 2 illustrates the mineral content. The calculation of the nutritional elements (DAVIDSON, 1979) showed that pollen is a good source of each and every mineral.

Table 2

Mineral content of pollen

Mineral	μg/g (dry matter)
Zinc	70
Iron	77
Copper	12
Natrium	1022
Potassium	6665
Phosphorus	3667
Calcium	2468
Magnesium	225

A high content of unsaturated fatty acids was found in pollen, with a unsaturated/saturated fatty acids ratio of 1.70 (Table 3). Moreover, pollen has a high content especially of linoleic and linolenic acids, fatty acids which are essential for man, and must be provided for in food because the human body is not able to synthetize them.

Table 3

Fatty acid content in pollen

Fatty acid	%
Caprylic (8:0)	not identified
Capric (10:0)	2.37
Lauric (12:0)	0.83
Miristic (14:0)	0.62
Palmitic (16:0)	12.39
Stearic (18:0)	6.18
Arachi (20:0)	3.64
Behenic (22:0)	7.27
Oleic (18:1)	15.38
Linoleic (18:2)	30.39
Linolenic (18:3)	12.46

The aminoacids identified in pollen and the quantitative calculation (%) according to the standard recommended by FAO/WHO/UNO in 1985 (WHO, 1985) are given in Table 4. The first limiting acid was tryptophan with a 83% content, much higher than that of the most plant proteins (FAO, 1990). A comparative study of the essential aminoacid constituents, with the FAO/WHO/UNO recommended standard, reveals that they are well represented in the proteins in pollen.

Table 4

Aminoacid content and quantitative calculation (QC) of pollen

	g/100 g protein		%
Aminoacid	Pollen	Control*	QC
Isoleucine	4.4	2.8	157
Leucine	7.3	6.6	111
Lysine	6.3	5.8	109
Methionine	2.1	—	—
Cystine	0.6	—	—
Meth+Cys	2.7	2.5	108
Phenylalanine	5.7	—	—
Tyrosine	3.2	—	—
Phen+Tyr	8.9	6.3	141
Threonine	3.8	3.4	112
Tryptophan	0.9	1.1	82
Valine	5.2	3.5	149
Histidine	4.5	—	—
Arginine	1.2	—	—
Aspartic	9.8	—	—
Serine	4.3	—	—
Glutamic	11.3	—	—
Proline	7.3	—	—
Glycine	4.4	—	—
Alanine	5.0	—	—
Total	87.3	—	—

* WHO, 1985

In Table 5 the protein content of pollen is given as compared with the protein content of other foods; the higher quality of the proteins in pollen as against that of proteins in plant foods is obvious.

In contrast to the results obtained by us, other authors (CABRERA, 1979, and BELL, 1983) reported sulphur aminoacids (methionine+cystine) and lysine — with no discrimination, as limiting aminoacids, result likely to be due to the characteristic features of the plant species from which the pollen had been collected.

Table 5

Quantitative calculation (QC) for various foods as compared to pollen

Food	QC (%)
Pollen	82
Bread	36
Maize	64
Rice	62
Bean	76
Chick pea	89
Soy-bean	103
Beef	122
Chicken meat	93
Tunny fish	103
Cow milk	133
Goat milk	90

The quantitative determination gave results significantly similar to the results of the bioassays on rats. The biological value of the proteins in pollen was 84%, value which is statistically similar to that obtained for casein (88%) which is used as reference for high quality protein. The digestibility of proteins was lower (79%) than that of casein (99%) but it is a normal value for plant proteins (SARWAR, 1987). The tests for identifying alcaloids, saponins, the cyan group, inhibitors of trypsin and lectin were negative. The polyphenols and phytic acid content was of 1475 and 1071 mg/100 g of sample respectively, values

which are considered as normal (ABREU, 1987; AYKROYD, 1982).

The toxicological assay did not show considerable differences for any of the variables considered, between the groups of animals fed with pollen and the group fed with casein. The figures are within the normal range of values for guinea pigs (WOLFOD, 1986). The results obtained show that the health of the animals fed with pollen was not affected by any change which could be identified by the tests made during our experiment, and consequently one may consider that ingestion of pollen was not found to cause adverse effects in laboratory animals.

The results mentioned above show that pollen has a high nutritional quality and is not toxic, and may therefore be used as food dor humans.

REFERENCES

ABREU, M. (1987) — Los polifenoles en los alimentos y sus efectos nutricionales, CENIC Rev. *Ciencias Biol.* 8:105—111

AYKROYD, W. R.; J. DOUGHTY (1982) — Las leguminosas en la nutrición humana. Estudios FAO: Alimentación y nutrición 20, Food Agriculture Organization (FAO), Rome, 1982

BELL, R. R. (1983) — Composition and protein quality of honey bee collected pollen of *Eucalyptus marginata* and *Eucalyptus calophylla, J. Nutr.* 113:2479—2482

BURRIEL, F. (1968) — Química analítica cuantitativa, Editora Revolucionaria, La Habana

CABRERA, J. (1979) — El polen, un recurso apícola de valor alimentario para mejorar la dieta de la población rural de las zonas áridas de México. Trabajo presentado en: XXVII Congreso Apícola, APIMONDIA, Atenas

CUMMINGS, J. H. (1980) — The role of dietary fibre in the human colon. *CMA Journal* 123:1109—1114

DAVIDSON, S. S.: R. PASSMORE; J. F. BROCK (1979) — Human nutrition and dietetic, 7th ed. Churchill Livingstone

DEV CHOUDHURY, M. N.; M. R. GOSWAMI (1983) — A rapid method for determination of total polyphenolic matters in tea *(Camellia sinensis), Two and bud.* 30:59—61

FOOD AGRICULTURE ORGANIZATION (1990) — Report of the Joint FAO/WHO Expert Consultation on Protein Quality Evaluation, Rome

HORWITZ, W. (1975) — Official methods of analysis, 12th ed. New York

JAFFE, W. G.; O. BRUCHER (1972) — Toxicidad y especificidad de diferentes fitohemaglutininas de frijoles *(Phaseolus vulgaris),* Arch. Latinoamer. Nutr. 22:267—281

KAKADE, M. L.; N. SIMON (1969) — An evaluation of natural vs synthetic substrates for measuring the antitryptic activity of soy bean samples, *Cereal Chem.* 46:518—521

MACKED, K. (1972) — Pharmaceutical applications of thin layer and paper chromatography, Elsevier Publishing Co., New York

METCALF, L. D.; A. A. SCHMITZ (1966) — Rapid preparation of fatty acid methyl esters from lipid for gas chromatographic analysis, *Anal. Chem.* 38:514—517

NAVARRO, L.; M. ABREU; T. GONZALEZ (1988) — *In vivo* technique for determina-

tion of the indigestible fraction (dietetic fibre) contained in a semisynthetic diet fed to rats, *Rev. Cub. Nutr. Alim.* 2:102—110

OBERLEAS, D. (1971) — The determination of phytate and inositol phosphate, *Met. Biochem. Anal.* 20:87—90

PAG/UNU (1983) — Guideline No. 6, Preclinical testing of novel foods, *Food Nutr. Bull.* 5:77—92

PELLET, P. L.; V. R. YOUNG (1980) — Nutritional evaluation of protein foods, The United Nations University, Tokyo

RONDINA, R. V.; J. D. CAUSSIO (1969) — Estudio fitoquímico de plantas medicinales argentinas (1), *Rev. Invest. Agrop.* 6:351—366

SARWAR, G. (1987) — Digestibility of protein and bioavailability of aminoacids in foods, *Wld. Rev. Nutr. Diet* 54:26—70

WHO (1985) — Energy and protein requirements, report of a Joint FAO/WHO/UNU Expert Consultation, Technical Report Series 724, Ginebra

WOLFOD, S. T.; R. A. SCHROER; F. X. GOHS (1986) — Reference range data base for serum chemistry and hematology values in laboratory animals, *J. Toxic, Envir. Health* 18:161—188

Author's address:
Instituto de Nutrición e
Higiene de los Alimentos
Infanta 1158
La Habana
CUBA