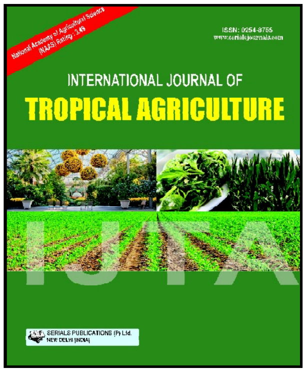

INTERNATIONAL JOURNAL OF TROPICAL AGRICULTURE

ISSN : 0254-8755

available at http: www.serialsjournals.com

Volume 37 • Number 1 • 2019

Contribution of Pumpkin Seeds Towards the Nutritional Characterization

Dimpal M. Zala* and J. J. Dhruv

Department of biochemistry, B. A. College of agriculture, AAU, Anand

Abstract: The present investigation was carried to enhance understanding regarding the nutraceutical molecules in seed of eleven pumpkin genotypes. The results revealed that moisture (6.09 %) and magnesium (2066 ppm) content were found higher in genotype GP PK 80, protein and cobalt content were found maximum in GP PK 29. The GP PK 105-1 was recognised with higher amount of total soluble sugars (1.01%), reducing sugars (0.91%), total oil (42.4%), free fatty acids (0.29% as oleic acid) and acid value (0.58 mg KOH/g). The total antioxidant activity (2.07 µM/g) and copper content (5.93ppm) were found maximum in GP PK 75. Total phenol (0.62%), zinc (30.40 ppm) and iron (26.53 ppm) content were found higher in GP PK 54, GP PK 132 and GP PK 77, respectively. The data on fatty profile suggested that pumpkin seed oil having high total unsaturated fatty acids as compare to the total saturated fatty acids.

INTRODUCTION

Pumpkin (*Cucurbita moschata* Duch. ex. Poir.) belongs to the family *cucurbitaceae* having somatic chromosome number 2n = 40. It is warm season crop. The centre of origin of pumpkin is Northem Mexico and southwestern and eastern USA. The genus cucurbita includes five domesticated varieties *Cucurbita argyrosperma, Cucurbita ficifolia, Cucurbita maxima, Cucurbita moschata, and Cucurbita pepo* from which three; *Cucurbita pepo* L., *Cucurbita maxima* D. and *cucurbita moschata* Duch. ex Poir. are very important globally both economically and for human consumption (Whitaker and Devis, 1962; Robinson and Decker-Walters, 1997).

Some researchers have shown that pumpkin seeds not only contain nutraceutically important bio-compounds but are also sources of other phyto-compounds which at certain critical levels have significant effects (Elinge *et al.,* 2012). Nutraceuticals refers to foods having a medicinal effect on health of human beings. It consists of food supplements, herbal products, probiotics and prebiotics, medical foods meant for prevention and treatment of diseases. (Shinde *et al.,* 2014)

Pumpkin has received considerable attention in recent years because of the nutritional and health protective values of the seeds. Pumpkin seeds are consume directly as snack food in many cultures throughout the world (Elinge *et al.,* 2012) Pumpkin seeds possess excellent health benefits. Pumpkin seeds are an extraordinarily rich source of nutraceutical, pharmaceutical, and cosmeceutical properties that exhibit many pharmacological effects and health benefits.

Pumpkin plant is an annual plant with leafy green vegetable; it has a climbing stem of up to 12m long and fruit with a round fibrous flesh. Pumpkin fruits are variable in size, colour, shape and weight; they have a moderately hard flesh with a thick edible flesh below and a central cavity containing the seeds. The seeds are covered with a testa which serves as a protectant around it. (Elinge *et al.,* 2012). Thus, the objective of this study was to evalute various nutracuetical molecules from pumpkin seed and to present the properties of this genotype for the human consumption.

MATERIALS AND METHODS

The present experiment was carried out at Biochemistry department, B. A. College of Agriculture, Anand Agricultural University, Anand. The seeds from fully mature and ripened pumpkin consisted of eleven genotypes viz., GP PK 23, GP PK 29, GP PK 54, GP PK 67, GP PK 75, GP PK 77, GP PK 80, GP PK 105-1, GP PK 132, GP PK 142 and AP 1 were obtained from the Main Vegetable Research Station, Anand Agricultural University, Anand. The recommended methods of the various parameters were adopted to determine.

The various nutritional character such as moisture (A.O.A.C, 1990), oil (Chaturvedi and Sanker, 2006), total antioxidant activity (Varga, 1998), total soluble sugars (Sadasivam and Manickam, 1992), reducing sugars (Nelson 1944), protein (Lowry 1951) and phenols (Malick and Singh, 1980) analysed with some modification. The non-reducing sugar was calculated from the difference between total soluble sugar and reducing sugar. Minerals contents were determined by inductively coupled plasma atomic emission spectroscopy.

RESULTS AND DISCUSSION

Moisture

Moisture plays an important role in seed germination and emergence. Significantly the higher (6.09%) and lower (2.41%) moisture content was recorded in GP PK 105-1 and GP PK 80, respectively. However the genotype GP PK 54 (5.76%) was recorded significantly at par with GP PK 105-1. (Fig. 1). Ardabili *et al.,* (2011) have found that the pumpkin seeds having 4-6% moisture content. Al-Anoos and his co wokers, (2015) found *Cucurbita maxima* seed moisture content 4.67g/100g, 5.53, 3.38 g/100g in Kafr El-batikh, Kafr Saad and Hongli, respectively.

Total soluble sugars, reducing sugars and non reducing sugars

The total soluble sugars, reducing sugars and non reducing sugars were determined and documented in Fig 3. Significantly higher total soluble sugar (1.01%) and reducing sugars (0.91%) was recorded for GP PK 105-1. However significantly minimum total soluble sugars content was found in GP PK 29 (0.46%) which was followed by GP PK 142 (0.50%), GP PK 75 (0.57%) and GP PK 67 (0.63%). Significantly lower reducing sugar content was found in GP PK 23 (0.16%). The non reducing sugars content was varied between 0.10 to 0.81%. Habib *et al.,* (2015) reported sugar content 1.08% in *Cucurbita maxima* seed. Rezig *et al.,* (2012) evaluted the pumpkin (*Cucurbita maxima*) seed having total sugars 0.11%

on dry weight basis. Kumar and Sandeep (2016) studied *Oryza sativa* seed having reducing sugars and non reducing sugars content 77 and 635 mg/g.

True protein

Significantly higher true protein was observed in GP PK 29 (10.73%) which was at par with GP PK 75 (10.62%) among all genotypes (Fig. 2). Significantly lower true protein content was observed in GP PK 142 (7.45%) which was followed by GP PK 77 (7.84%) and GP PK 23 (8.04%). The protein constituents are of primary importance not only as component of nuclear and cytoplasmic structures, but also as complement of enzyme involved in metabolism during growth. (Habib *et al.,* 2015). Our result was found lower protein content as compared to the result of Habib *et al.* (2015), they found *Cucurbita maxima* Linn. 18.1 % total soluble proteins. Karanja *et al.,* (2013) deliberate that *Cucurbita* spp. seed protein varying between 14.05 to 33.29%.

Phenol

The result of total phenol content of pumpkin seed was obtained range from 0.26 to 0.62%. (Fig 4). Significantly the highest total phenol was observed in GP PK 54 (0.62%). The significantly lower total phenol content was observed in GP PK 67 (0.26%), which was at par with GP PK 29 (0.28%). The results indicate that vegetables containing high phenolic may provide a source of dietary anti-oxidants. The phenolic compounds may contribute directly to the antioxidant action; therefore, it is necessary to investigate total phenolic content (SyedaBirjees Bukhari *et al.,* 2008). Ethiraj and Balasundaram (2016) reported total phenol content in *Cucurbita pepo* (8.37±0.2mg GAE/ g) and *Cucurbita maxima* (5.21±0.1mg GAE/ g). Zhong *et al.* (2007) reported that pumpkin seed amount to 3.9 mg caffeic acid equivalents per gram of oil (CFAE/g). Fruhwirth *et al.* (2007) noticed the total phenol content (29 mg GAE/g) in pumpkin seed.

Total antioxidant activity

The total antioxidant activity was measured in pumpkin seed and presented in Fig 4. The results revealed that significantly maximum total antioxidant activities content recorded for GP PK 75 (2.07 µM/g) which was significantly at par with GP PK 23 (2.03 µM/g) and GP PK 54 (2.02 µM/g). The minimum lower total antioxidant activities content was observed for GP PK 105-1 (1.74 µM/g) which was at par with GP PK 67 (1.77 µM/g). Antioxidants are an atom donor of an electron to a free radical. If a molecule has one or more unpaired electron it works as a free radical. During oxidation free radicals are produced which can damage the cells. Antioxidants are responsible for terminating the chain reaction by removing free radicals (Singh *et al.,* 2012). Kubola and Siriamornpun reported total antioxidant activity of *Momordica cochinchinensis* Spreng fully ripe seed having 46.49 µM/g.

Oil

The total oil content found significantly higher and lower in GP PK 105-1 (42.4%) and GP PK 77 (16.54%) respectively. (Fig. 5) Lipid is more useful in animal body. Fat serves as efficient source of energy and insoluble material. Dietary fat helps in the absorption of fat soluble vitamins, lipoproteins are important cellular constituents. These results are in agreement with the results observed by Ardabili *et al.,* (2011), they reported 38.88 to 44.3 % oil content in the seeds of *Cucurbita pepo* L. Montesano *et al.,* (2018) stated 29.0 % seed oil in *Cucurbita maxima* L. (var. Berrettina)

Free fatty acid and Acid value

The maximum free fatty acid content (Fig 6) was recorded higher in GP PK 105-1 (0.29%), which was significantly at par with GP PK 132 (0.28%) and GP PK 142 (0.28%), significantly minimum free fatty acid content was found in GP PK 77 (0.17%).

Fatty acids are found in the triglyceride form, however, during precessing the fatty acids may get hydrolyzed into free fatty acid. The higher the acid value found, the higher the level of free fatty acids which translates into decreased oil quality. These results are in agreement with the results observed by Ardabili *et al.,* (2011), they estimated free fatty acid value in the (*Cucurbita pepo* L.) seeds contained 0.39 % as oleic acid which is higher than our result. Eddy *et al.,* (1987) reported free fatty acid (FFA) amount about 0.38%. Alfawaz (2004) studied in *Cucurbita maxima* free fatty acid 0.27% as oleic acid and acid value 0.53 mg KOH/ g oil. In present investigation acid value was found significantly higher in GP PK 105-1 (0.58 mg of KOH / g) and significantly lower in GP PK 77 (0.34 mg of KOH /g) pumpkin genotype which is presented in Fig 6. The non significant difference of acid value recorded among GP PK 132 (0.56), GP PK 142 (0.56), and GP PK 105-1 (0.58). These results are in agreement with the results observed by Ardabili *et al.,* (2011) and they estimated acid value in the (*Cucurbita pepo* L.) seeds contained 0.78 mg KOH/g oil. Alfawaz (2004) studied chemical composition and oil characteristics of pumpkin (*Cucurbita maxima*) seed kernels and reported acid value 0.53 mg KOH/ g oil.

Minerals

It play a vital role as a cofactor of cobalamine (Vitamin B12) which functions as a coenzyme involved in N2 fixation and nodule growth (Minz *et al.,* 2018). Cu ions act as cofactor in many enzymes such as Cu/Zn superoxide dismutase (SOD), cytocrome c oxidase, amino oxidase, laccase, plastocyanin and polyphenol oxidase. (Yruela, 2005) . Iron is an importance element in crops, because it is essential for many important enzymes, including cytochrome that is involved in electron transport chain, synthesize chlorophyll, maintain the structure of chloroplasts, and enzyme activity. (Eskandari, 2011). Magnesium is essential mineral for enzyme activity, like calcium and chloride; magnesium also plays a role in regulating the acid-alkaline balance in the body (Fallon, 2001). Zinc plays a part in the basic roles of cellular functions in all living organisms and is also involved in improving the human immune system (Hafeez *et al.,* 2013).

The total amount of cobalt content of different pumpkin genotype varied between 260 ppb – 99 ppb. GP PK 29 showed significantly higher cobalt content (260 ppb) followed by GP PK 80 (247 ppb), whereas genotype GP PK 75 has lowest (99 ppb) cobalt. (Fig 7).

The result revealed that significantly higher copper content recorded for GP PK 75 (5.93 ppm) while significantly lower copper content was observed for GP PK 54 (2.46 ppm).Overall it can be concluded that significantly higher and lower copper content was observed in GP PK 75 (5.93 ppm) and GP PK 54 (2.46 ppm), respectively. (Fig 8).

In present investigation iron content was found significantly higher in GP PK 77 (26.53 ppm) and significantly lower in GP PK 67 (12.53 ppm) pumpkin genotype which is demonstrated in Fig 8.

The magnesium ion was found significantly differed with each other for all genotype. However it was recorded higher in GP PK 80 (2066 ppm) and lower in GP PK 54 (448 ppm).

The total amount of zinc content of different pumpkin genotype ranged from 8.70 ppm –30.40 ppm. GP PK 132 (30.40 ppm) showed significantly higher zinc content followed by GP PK 80 (26.13 ppm), whereas genotype GP PK 23 has lowest (8.70 ppm) zinc. It is showed in Fig 8. Devi *et al.,* (2018) reported the cobalt content in pumpkin seed kernel was found 0.6 mg/100g. Alfawaz (2004) found Zn, Cu and Mg content 1.09 mg/100g, 0.30 mg/100g and 364.43 mg/100g, respectively content in pumpkin seed. Elinge *et al.,* (2012) reported iron content 3.75 mg/100g in pumpkin seed. Habib *et*

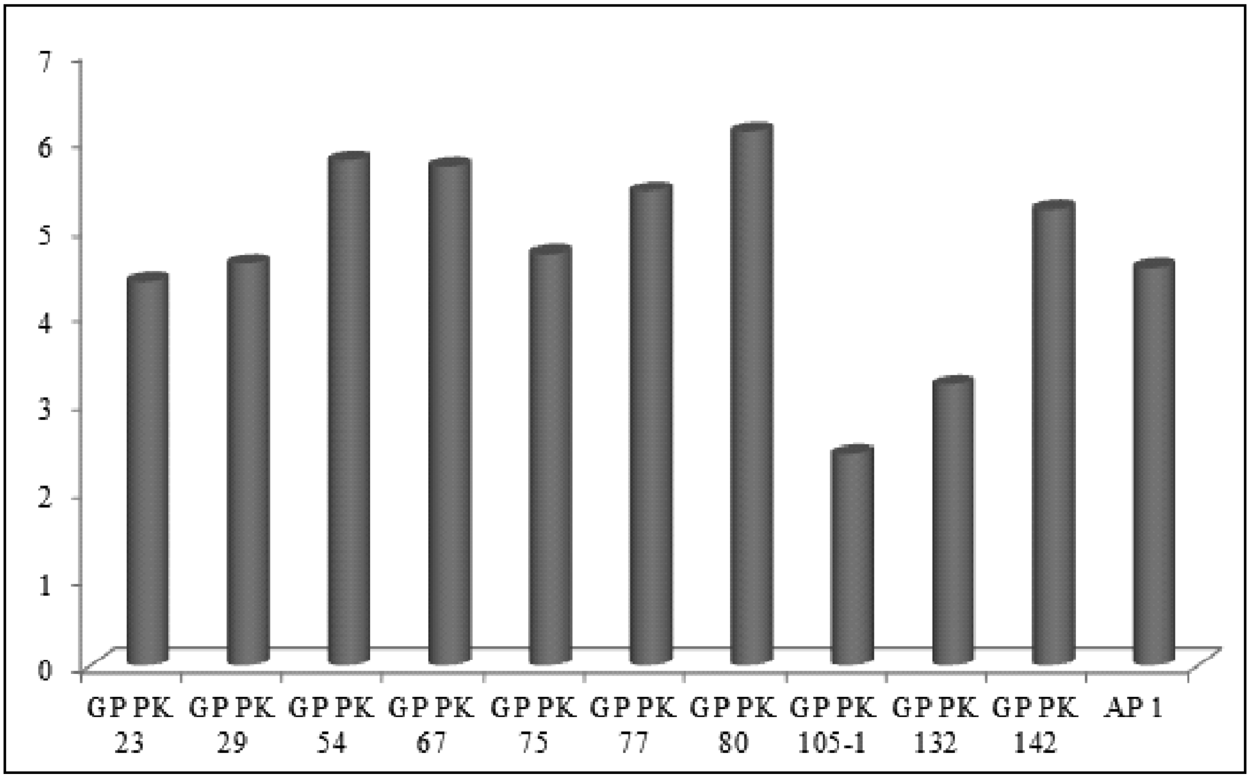

Figure 1: Moisture content in pumpkin seed

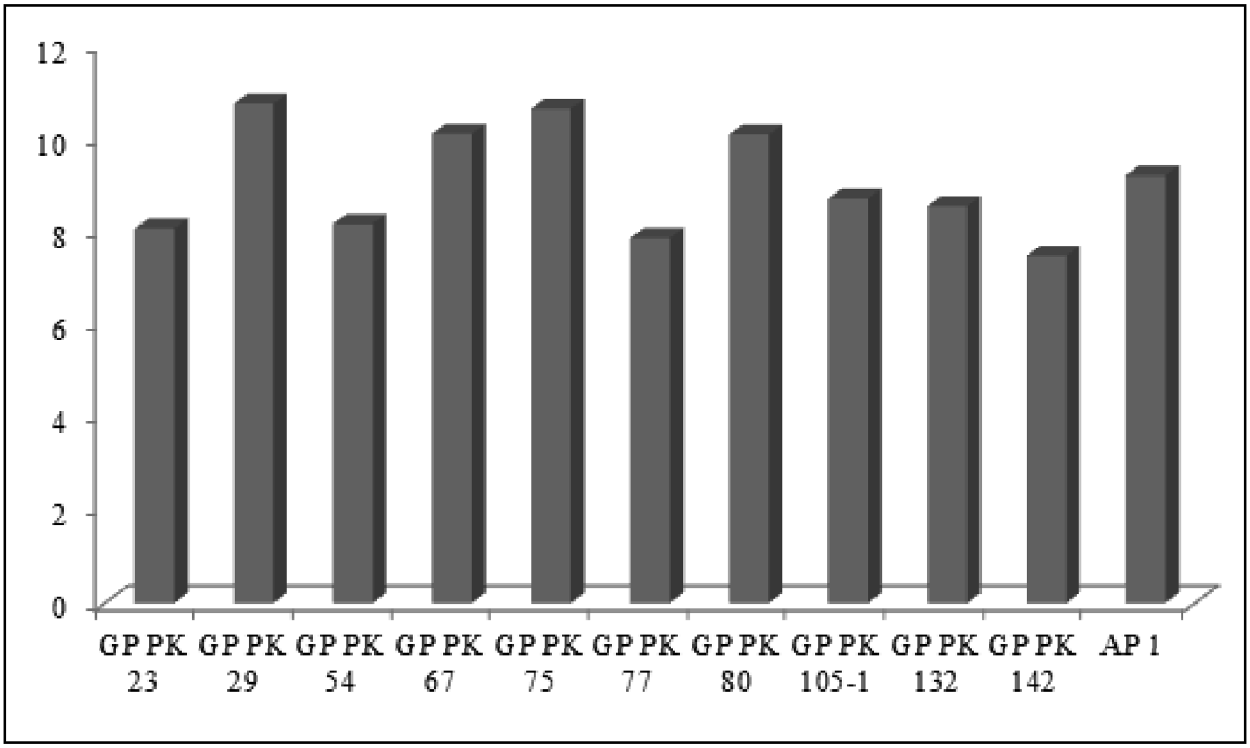

Figure 2: True protein content in pumpkin seed

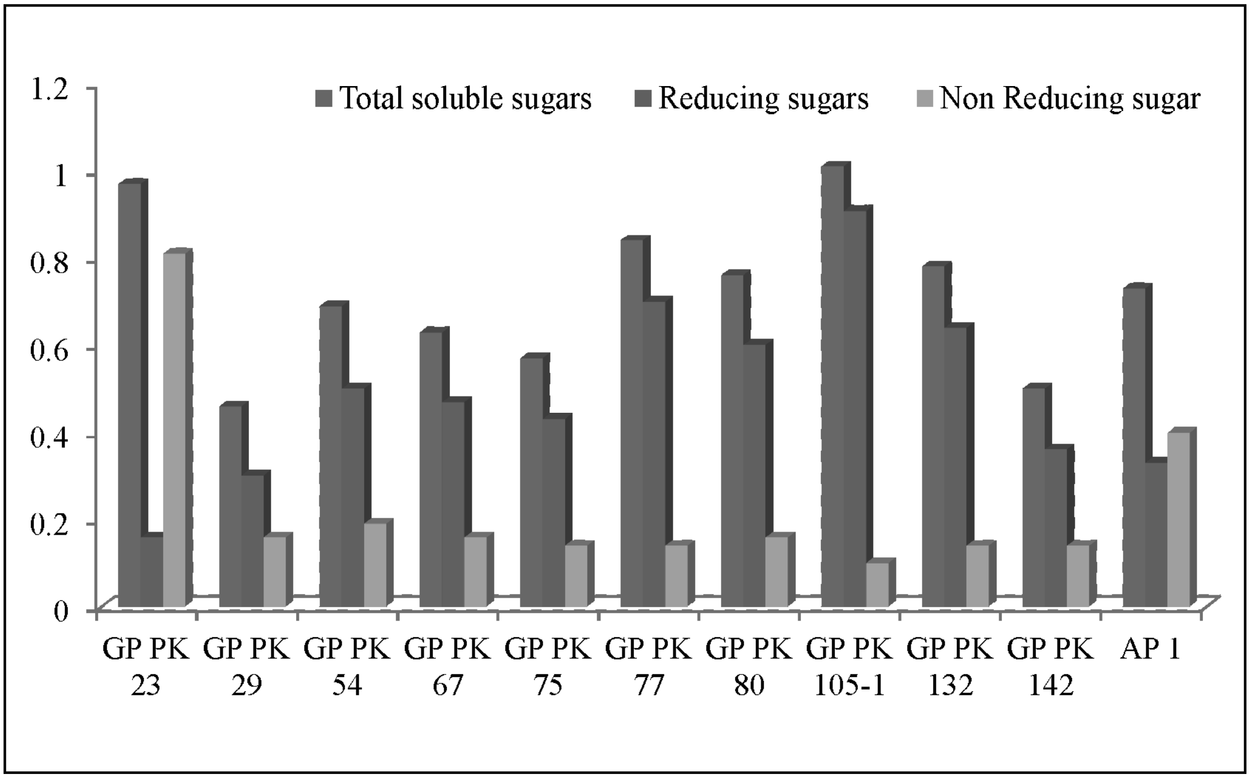

Figure 3: Total soluble sugar, reducing sugars and non reducing sugars in pumpkin seed

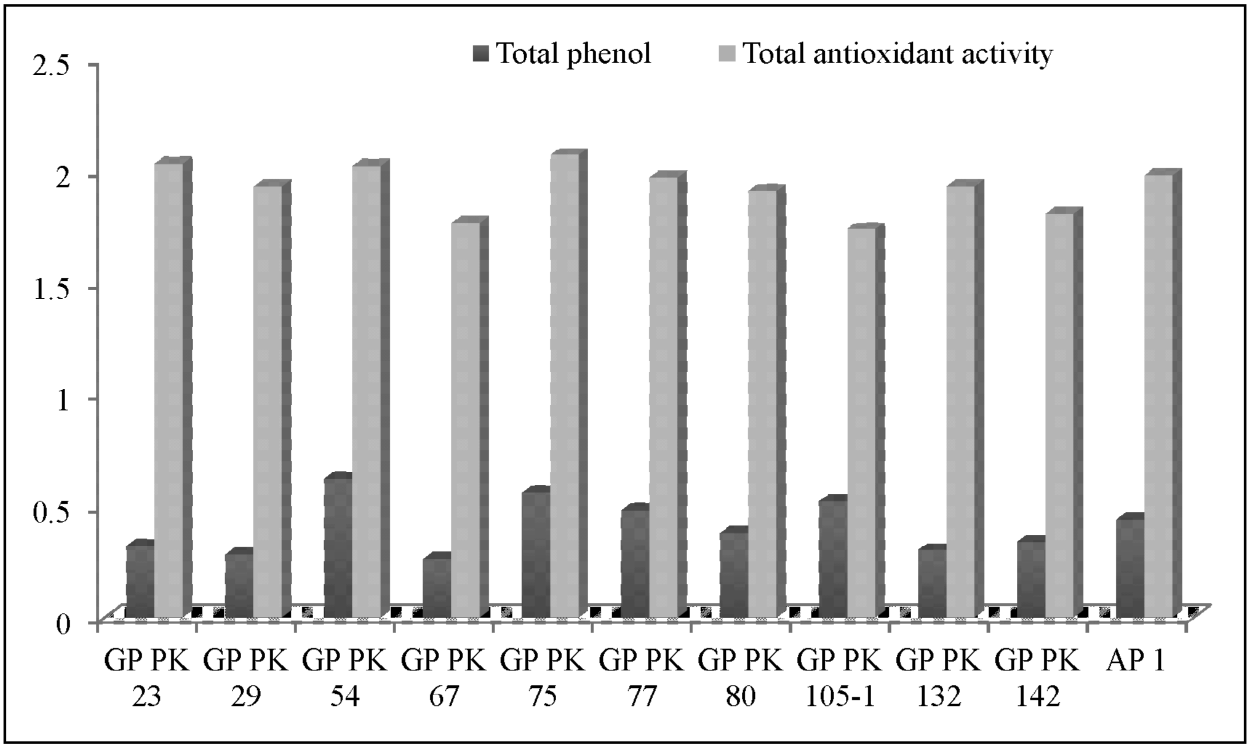

Figure 4: Total phenol and total antioxidant activity in pumpkin seed

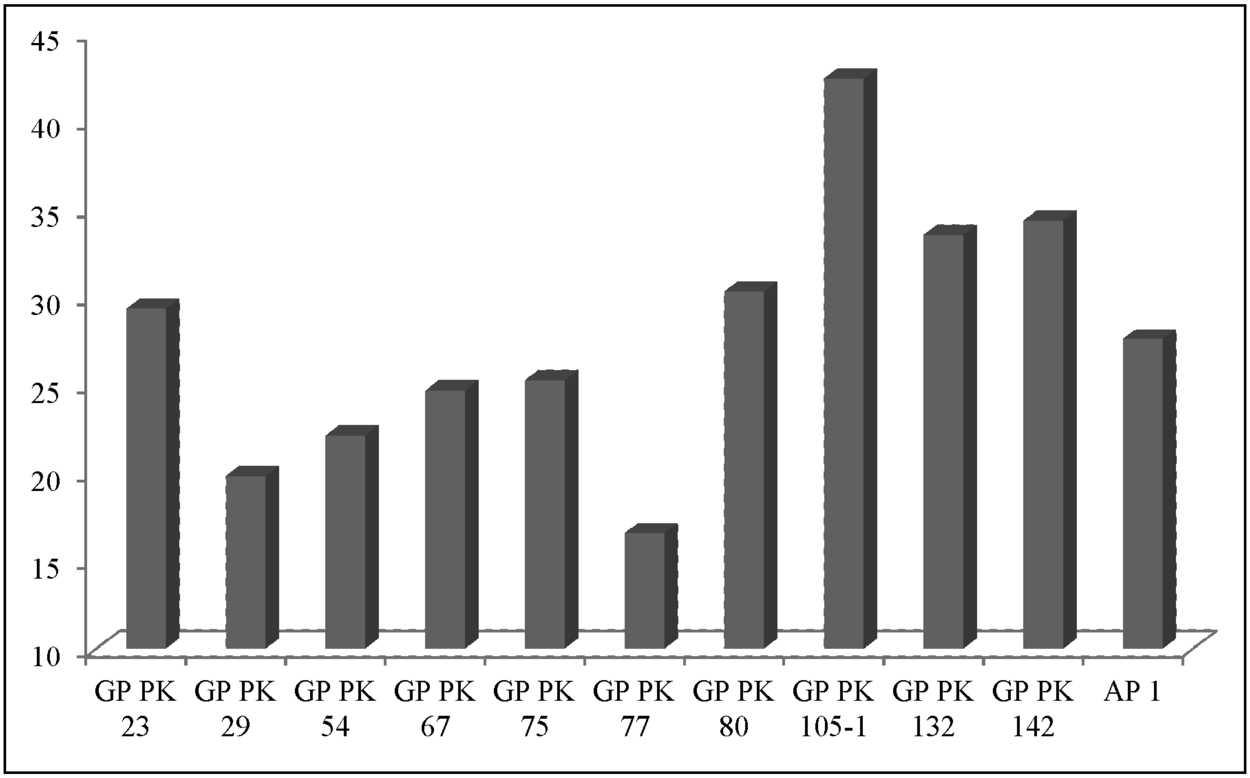

Figure 5: Total oil content in pumpkin seed

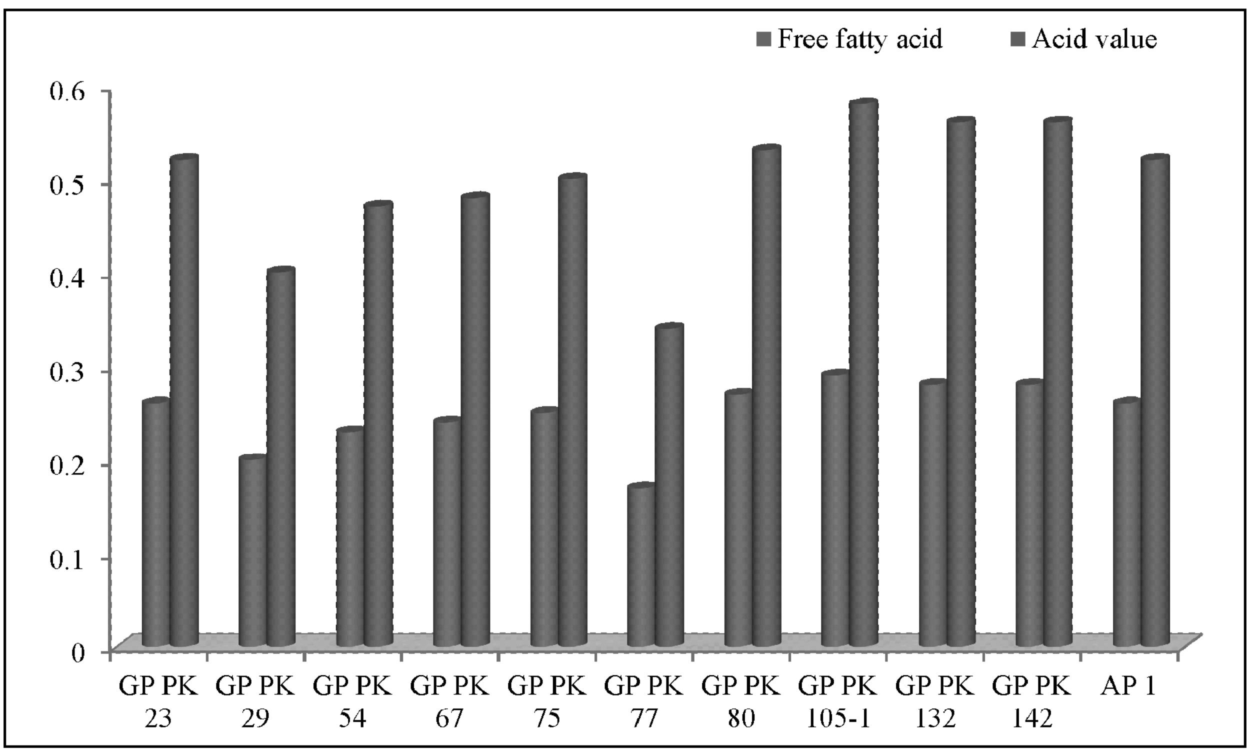

Figure 6: Free fatty acids content in pumpkin seed

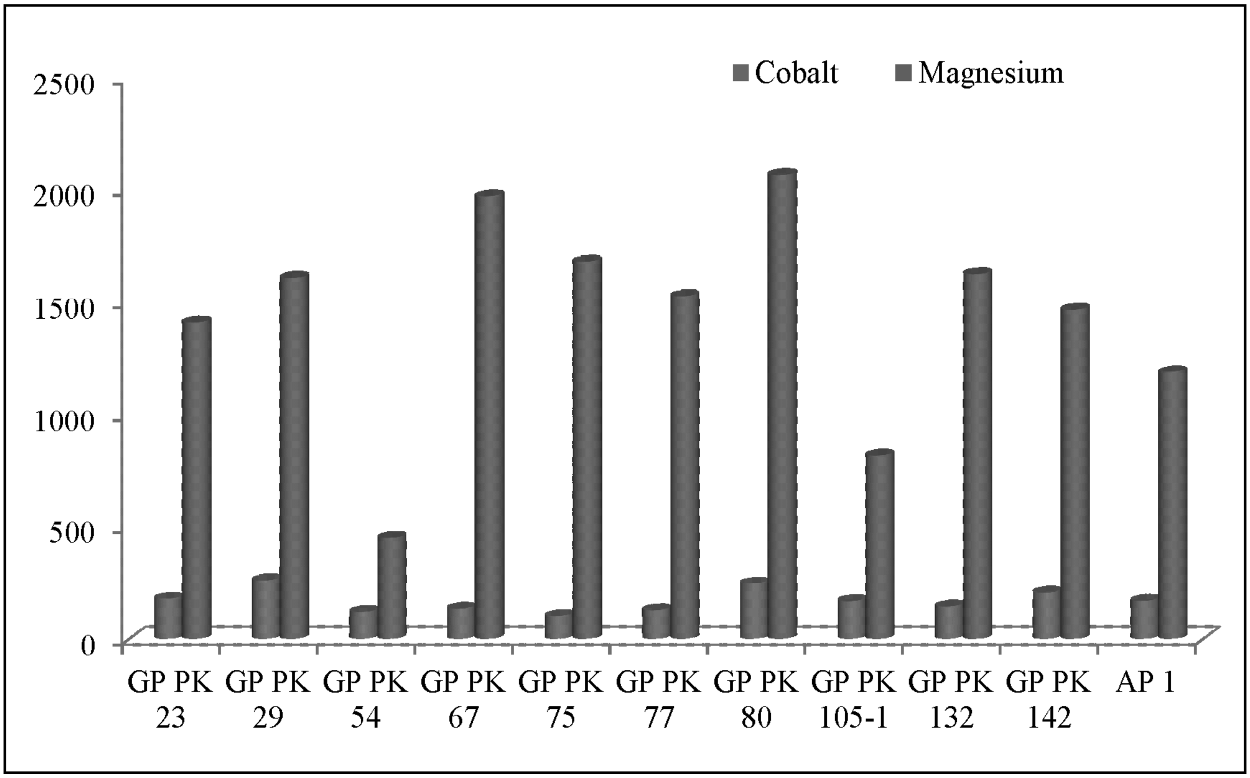

Figure 7: Cobalt and magnesium content in pumpkin seed

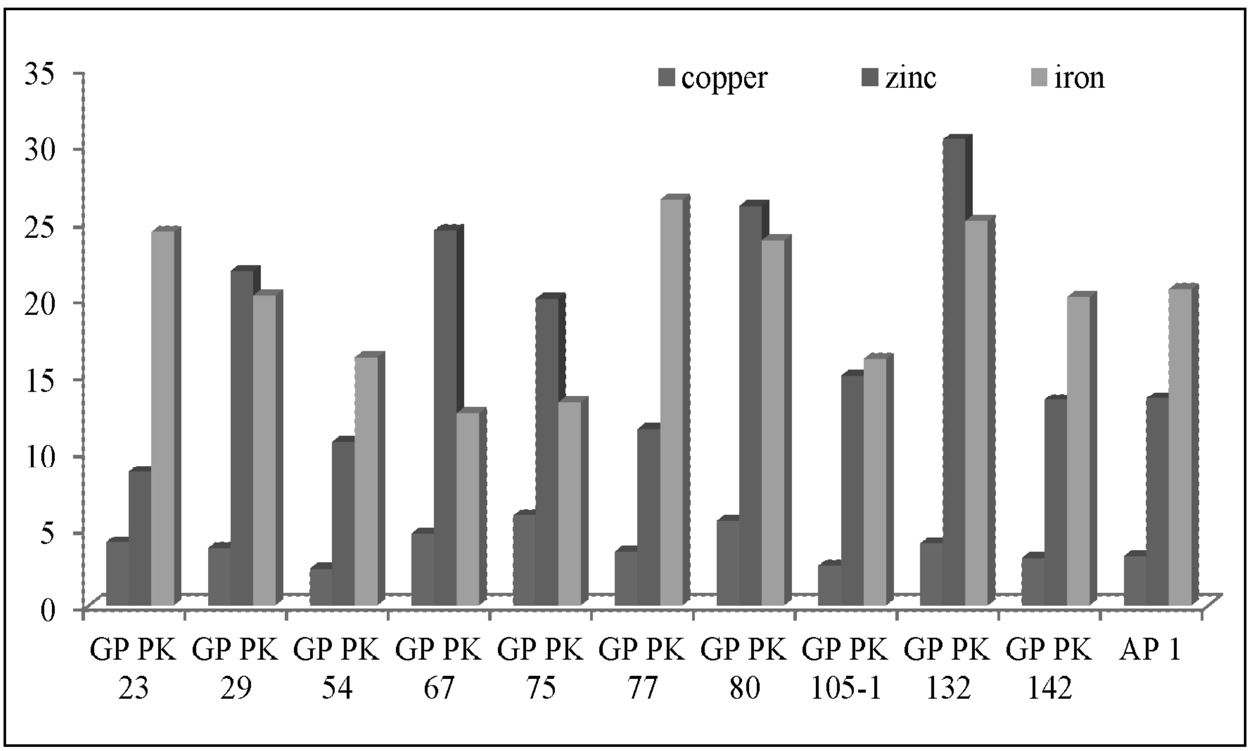

Figure 8: Copper, zinc and iron content in pumpkin seed

al., (2015) observed that seed having iron 290.0 ppm. Habib *et al*., (2015) observed that *Cucurbita maxima* seed having zinc, copper and magnesium content 39.9 ppm, 70 ppm and 348.7 ppm, respectively.

Fatty acids are major components of cell membrane structure, modulate gene transcription, function as cytokine precursors, and serve as energy sources in complex, interconnected systems. It is increasingly apparent that dietary fatty acids influence these vital functions and affect human health. (Glick and Fischer, 2013).

The oil of pumpkin seed was analysed for fatty acid profile and the result is demonstrated in table 4. The contents of saturated fatty acids palmitic acid (C16:0), stearic acid (C18:0) and behenic acid (C 20:0) are in the ranged between 5764.66 – 33615.60 ppm, 3876.12 – 23748.90 ppm and 34.25 – 501.63 ppm, respectively. The unsaturated fatty acid like oleic acid, linoleic acid, linolenic acid and erucic acid are varied between 22766.1 – 117763 ppm, 26805.2 – 151865 ppm, 513.29 – 2154.64 ppm and 16.87 – 4057.13 ppm, respectively. Total saturated fatty acids were higher in GP PK 54 and lower in AP 1 while total unsaturated fatty acid were also higher in GP PK 54 and lower in AP 1 except linolenic acid which was higher in GP PK 132 and lower in AP 1. Rezig *et al.,* (2012) reported major fatty acids oleic, linoleic, and palmitic acids were 44.11%, 34.77%, and 15.97%, respectively in pumpkin seed. Procida *et al,* (2012) stated higher content of linoleic acid (44.30–51.58%) and oleic acid (34.16–42.59%) in the pumpkin seed oil. Karanja *et al.,* (2013) reported the palmitic acid (1.16-20.81%), stearic acid (0.16-5.56%), oleic acid (15.56-30.79%) and linoleic acids (26.18-81.21%) in pumpkin seed oil.

CONCLUSION

Overall it can be concluded that in seeds total soluble sugars, reducing sugars, total oil, free fatty acids, and acid value were found higher in genotype GP PK 105-1 While, The genotype GP PK 132 having higher linolenic acid which may be useful for enhancing nutracuetical biomoleclues through breeding programme.

Table 1

Fatty acids contents in various pumpkin genotypes

Sr. No.	*Name of genotype*	*Palmitic acid (ppm)*	*Stearic acid (ppm)*	*Behenic acid (ppm)*	*Oleic acid (ppm)*	*Linoleic acid (ppm)*	*Linolenic acid (ppm)*	*Erucic acid (ppm)*
1	GP PK 23	23810	15018	187	94548	103288	2047	90
2	GP PK 29	24520	11664	112	70754	104305	1619	67
3	GP PK 54	33615	23748	501	117763	151865	1209	4057
4	GP PK 67	10531	6773	131	36526	45090	1002	1101
5	GP PK 75	10945	6729	97	37600	45236	900	345
6	GP PK 77	11929	7465	78	32672	60519	930	16
7	GP PK 80	18877	12258	185	77394	78546	1660	38
8	GP PK 105-1	13776	8194	149	67218	44565	1151	32
9	GP PK 132	27630	15039	364	113877	121545	2154	158
10	GP PK 142	14144	8604	111	56289	50876	1287	69
11	AP 1	5764	3876	34	22766	26805	513	275

REFERENCES

Al-Anoos IM, RAH El-dengawy, and Hany A. Fahmy (2015). Studies on Chemical Composition of Some Egyptian and Chinese pumpkin (*Cucurbita maxima*) Seed Varieties. *Journal of Plant Science & Research*, 2(2): 1 – 4.

Alfawaz, M. A. (2004). Chemical composition and oil characteristics of pumpkin (*Cucurbita maxima*) seed kernels. *Food Science and Agriculture*, 2(1), 5-18.

Ardabili Gohari A., Farhoosh R., and Haddad Khodaparast M. H. (2011). Chemical composition and physicochemical properties of pumpkin seeds (*cucurbita pepo* subsp. pepo var. styriaka) grown in iran. *J. Agr. Sci. Tech.*, 13:1053-1063.

Bukhari, S. B., Bhanger, M. I., & Memon, S. (2008). Antioxidative activity of extracts from a Fenugreek seeds (*Trigonella foenum*-graecum). Pakistan Journal of Analytical & Environmental Chemistry, 9(2), 6.

Chaturvedi RK and Sankar K. Laboratory Manual for the physicochemical analysis of soil, water and plant; 2006.p. 64. Dehradun L: Wild life institute of India.

Devi, N. M., & Palmei, R. P. G. (2018). Physico-chemical characterisation of pumpkin seeds. *IJCS*, 6 (5), 828-831.

Eddy N.O., Ukpong J.A. and Ebenso E. E., (1987). Lipids characterization and industrial potentials of pumpkin seeds (*Telfairia occidentalis*) and cashew nuts (*Anacardium occidentale*) *E-Journal of Chemistry*, 8(4).

Elinge C. M., Muhammad A., Atiku F. A., Itodo A. U., Peni I. J., Sanni O. M. And Mbongo A. N. (2012). Proximate, mineral and anti-nutrient composition of pumpkin (*Cucurbita pepo* L.) seeds extract. *International Journal of Plant Research*, 2(5): 146-150.

Eskandari, H. (2011). The importance of iron (Fe) in plant products and mechanism of its uptake by plants. *J. Appl. Environ. Biol. Sci*, 1(10), 448-452.

Ethiraj, S., & Balasundaram, J. (2016). Phytochemical and Biological Activity of Cucurbita Seed Extract. *Journal of Advances in Biotechnology.*, 6: 813 – 821.

Fallon, S., Enig, M. G., & Murray, K. (2001). *Nourishing traditions: The cookbook that challenges politically correct nutrition and the diet dictocrats*. Washington, DC: New Trends Publishing.

Fruhwirth, G. O., & Hermetter, A. (2007). Seeds and oil of the Styrian oil pumpkin: Components and biological activities. European *Journal of Lipid Science and Technology*, 109(11), 1128-1140.

Glick, N. R., & Fischer, M. H. (2013). *Journal of Evidence-Based Complementary & Alternative Medicine 18*(4) 268-289.

Habib, A., Biswas, S., Siddique, A. H., Manirujjaman, M., Uddin, B., Hasan, S., ... & Rahman, M. (2015). Nutritional and lipid composition analysis of pumpkin seed (*Cucurbita maxima* Linn.). Journal of Nutrition & Food Sciences, 5(4), 1.

Hafeez, B., Khanif, Y. M., & Saleem, M. (2013). Role of zinc in plant nutrition-a review. *American journal of experimental Agriculture*, 3(2), 374.

Karanja, J. K., Mugendi, B. J., Khamis, F. M., & Muchugi, A. N. (2013). Nutritional composition of the pumpkin (Cucurbita spp.) seed cultivated from selected regions in Kenya. *Journal of Horticulture Letters*, *3*(1), 17.

Kubola, J., & Siriamornpun, S. (2011). Phytochemicals and antioxidant activity of different fruit fractions (peel, pulp, aril and seed) of Thai gac (*Momordica cochinchinensis* Spreng). *Food chemistry*, 127(3), 1138-1145.

Kumar K.M. and Sandeep B.V. (2016) Comparative study of proximate composition and total antioxidant activity in leaves and seeds of *Oryza sativa* and *Myriostachya wightiana*. International Journal of Advanced Research 4, (2) 842-852.

Lowry, O H, Rosebrough, N J, Farr, A L and Randall, R J (1951) J boil chem193265.

Malik CP, Srivastava AK (1982). Text book of plant physiology. New Delhi: Ludhiana.

Minz *et al.,* (2018) A Review on Importance of Cobalt in Crop Growth and Production International Journal of Current Microbiology and Applied Sciences Special Issue- 7. 2978-2984.

Montesano, D., Blasi, F., Simonetti, M., Santini, A., & Cossignani, L. (2018). Chemical and nutritional characterization of seed oil from *Cucurbita maxima* L.(var. Berrettina) pumpkin. *Foods*, 7(3), 30.

Nelson, N: A photometric adaptation of the somogyi method for determination of glucose. J. Biol. Chem. 1944; 153: 375-380.

Procida, G., Stancher, B., Cateni, F., & Zacchigna, M. (2013). Chemical composition and functional characterisation of commercial pumpkin seed oil. *Journal of the Science of Food and Agriculture*, 93(5), 1035-1041.

R.W. Robinson and D.S. Decker-Walters. (1997) Cucurbit, New York, : CAB International. https://trove.nla.gov.au/version/39948548 226.

Rezig, L., Chouaibi, M., Msaada, K., & Hamdi, S. (2012). Chemical composition and profile characterisation of pumpkin (Cucurbita maxima) seed oil. *Industrial Crops and Products*, 37(1), 82-87.

Sadasivam, S. and A. Manickam. In: Biochemical Methods for Agriculture Sciences, Wiley Eastern Limited, New Delhi: 1992; 11-12.

Shinde, N., Bangar, B., Deshmukh, S., & Kumbhar, P. (2014). Nutraceuticals: A Review on current status. *Res J Pharm Tech*, 7(1), 110-113.

Varga I SZ, Matkovics B, Sasvari M, Salgo L. Comparative of plasma antioxidant status in normal and pathological cases.Curr Topic Biophys, 1998; 22 (suppl): 219-224.

Whitaker T. W. and Davis G. N. (1962). Cucurbits-botany, cultivation and utilization. Leonard Hill, London, United Kingdom, p. 249.

Yruela I. (2005) copper in plant Braz. *J. Plant Physiol.*, 17 (1):145-156.

Zhong,H. Y. Bedgood, D. R. A. G. Bishop, P. D. Prenzler, K. And Robards (2007): Endogenous biophenol, fatty acid and volatile profiles of selected oils. *Food Chem.*, 100:1544–1551.