Animal welfare, etológia és tartástechnológia

AWETH

http://www.animalwelfare.szie.hu

Animal welfare, ethology and housing systems

Volume 9 Issue 3

Különszám/Special Issue

Gödöllő
2013

Pasta preparation by coloured natural antioxidants

*Zsuzsanna Kiss, Annamária Kerti, Csaba Szabó, Krisztina Karchesz, László Bárdos**

Department of Animal Physiology & Health, Szent István University, Gödöllő, Hungary
*bardos.laszlo@mkk.szie.hu

Abstract

Our aim was to prepare pastas with different colours by using natural antioxidant containing foods as additives. The tomato and paprika contain red colours ingredients lycopene and capsanthin and capsorubin respectively. Spinach is chlorophyll rich food plant and it contains a lot of lutein too. These model pasta beside their uncommon colours have better biological activities and can be used as functional food.

Wheat flour was used for the preparation of pastas. The spinach puree for the green pasta, tomato puree, and red paprika powder for the red coloured pasta.

The surface colours of paste were determined by handy spectrometers (Micromatch™ Sheen Ltd) which use the international standard of CIELAB values. The coloration was successful by the additives and can be seen before and after cooking.

It was a fact that the colouring by paprika has not changed. In the other cases there were more or less alterations of CIELAB values. The chlorophyll content of spinach and lycopene content of tomato puree was analyzed. Three antioxidant reactions of pastas were characterized by ABTS, DPPH and FRAP methods respectively.

The measurements of antioxidant capacity of different components showed a ranking order. These additives increase the antioxidant capacity of paste that they have health protective effects.

Keywords: coloured pasta, antioxidant capacity, ABTS, DPPH, FRAP

Introduction

Functional foods are foods that have a potentially positive effect on health beyond basic nutrition. To produce such a foods sometimes new ingredients has been added to it and the new product has a new function often related to health-promotion or disease prevention. Epidemiological and experimental evidence associating diets rich in fruits and vegetables with prevention of chronic diseases such as cancer has stimulated interest in plant food phytochemicals as physiologically active dietary components.

Our aim was to prepare pastas with different colours by using natural antioxidant containing foods as additives. The tomato and paprika contain red colours ingredients (lycopene and capsanthin and capsorubin respectively. Spinach is chlorophyll rich food plant and it contains a lot of lutein too. These model pasta beside their uncommon colours have better biological activities and can be used as functional food.

Lycopene is a carotenoid and phytonutrient found in red fruits and vegetables such as tomatoes, pink grapefruits, watermelons etc. It is the compound that is responsible for the red colour in these foods. Numerous studies have shown that ingesting lycopene-rich foods can result in positive health benefits. (Britton, et al. 2009).

Oxidative stress is one of the major contributors to increased risk of some diseases. Lycopene is a very effective antioxidant. A diet rich in lycopene containing tomato products has been found to protect against these chronic diseases by mitigating oxidative damage. (Rao, 2004). Considerable evidence suggests that lycopene, has significant antioxidant potential in vitro and may play a role in preventing prostate cancer and cardiovascular disease in humans. (Arab and Steck 2000)

Prostate cancer is the most common cancer in men population in the industrialized countries. Recent epidemiological studies have suggested a potential benefit of this carotenoid against the risk of prostate cancer (Giovannucci, 2002).

The green colour chlorophyll and its various derivatives are believed to be among the family of phytochemical compounds that are potentially responsible for such associations. (Ferruzzi and Blakeslee, 2007).
Diets high in red meat and low in green vegetables are associated with an increased risk of colon cancer. The red meat, containing high quantity of heme, increases colonic cytotoxicity and proliferation of the colonocytes, whereas addition of chlorophyll from green vegetables inhibits these heme-induced effects. Chlorophyll completely prevented these heme-induced effects (De Vogel et al 2005). The bioavailability of lutein from spinach is very good independently of the dietary fiber content (Castenmiller et al. 1999).

Materials and Methods

Preparation of pasta

Wheat flour was used for the preparation of pasta. The common and special additives were the next: frozen spinach puree for the green pasta, tomato puree, and red paprika powder for the red coloured pasta. The composition and rations of different pasta are in the Table 1.

Table 1.

Composition of model paste

Mark	flour (g)	additive (g)	whole egg	Water* (ml)
Control	100	0	1	6,0
Tomato 5		5		6.8
Tomato 10		10		1.8
Paprika 5		5		10
Paprika 10		10		12
Spinach 5		5		6,8
Spinach 10		10		2.0

*Differences of water due to the different dry material contents of additives

Colour measurement

The surface colours of paste were determined by handy spectrometers (Micromatch™ Sheen Ltd) which use the international standard of CIELAB values (Figure 1.)

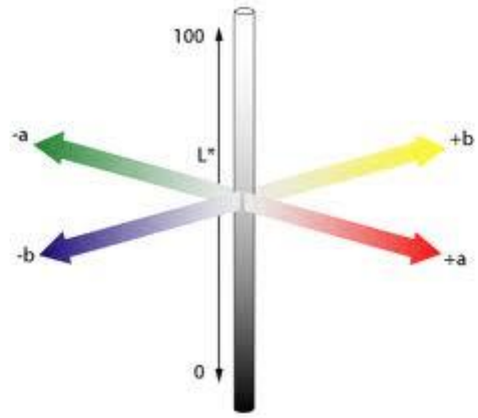


Figure 1.

The coordinates of the CIELAB principles

L = Luminosity, (surface) (0-100); a* =red – green; b* = yellow - blue

The CIELAB values were recorded every week for a month.

Analytical procedures

The chlorophyll content of spinach was measured by the „actual-trophic value” which is commonly used by the characterizations of phytoplankton chlorophyll contents (Felföldy, 1987).

The lycopene content of tomato puree was analyzed by the specific molar absorption coefficient of lycopene at 504 nm (Rodrigez-Amaya, 2001).

Characterization of antioxidant activities

Tree antioxidant reactions were used:

- ABTS (2,2'-azino-bis(3-ethylbenzthiazoline-6-sulphonic acid) procedure (Ozgen et al. 2006) which was characterized by Trolox equivalent antioxidant capacity (TEAC).
- DPPH (1,1-difenil-2-pikrilhidrazil) reaction (Ozgen et al. 2006)
- FRAP-(Ferric Reducing Ability of Plasma) (Benzie and Strain, 1996)

Statistical analysis

The statistical calculations were performed using GraphPad Prism version 5.00 for Windows, GraphPad Software, San Diego California USA, www.graphpad.com".

Results and Discussion

The coloration was successful by the additives. This can be seen before and after cooking in the pictures 1 and 2.

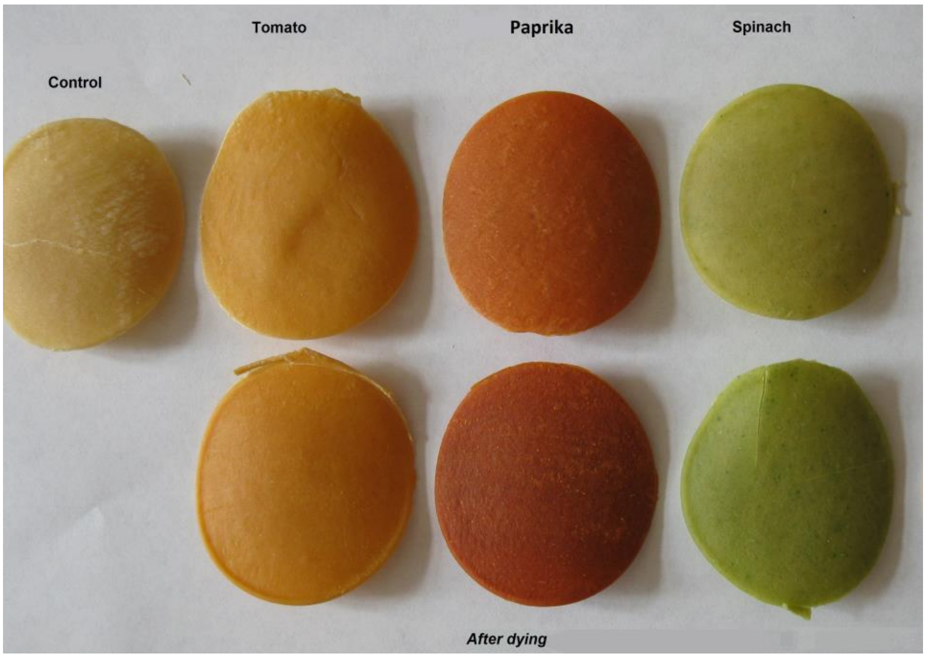
Picture 1.

The coloured pastas before cooking

Picture 2.

The coloured pastas after cooking

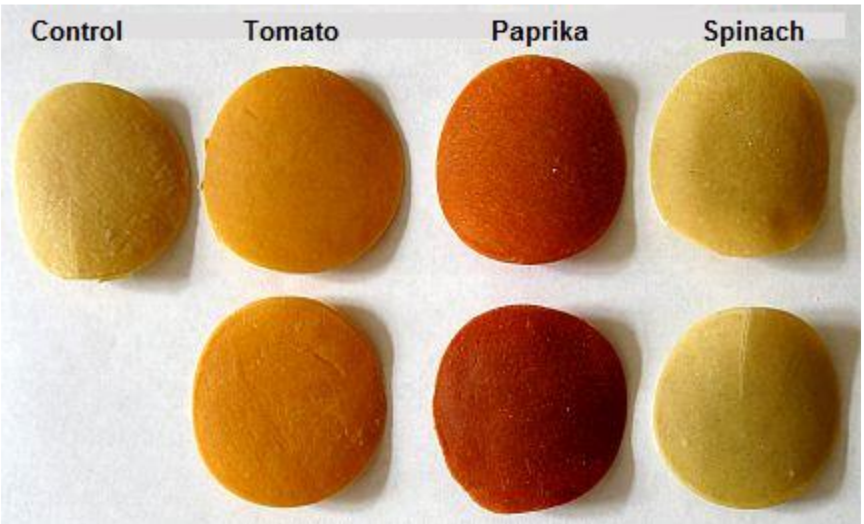
The picture 3 shows the original colours of paste after the dry. On the pictures 5 and 6 show the same pasta after one month of storage. The environmental conditions of storage were different. One group of dry pasta was stored in the laboratory (*Picture 4 and 5.)* and the other in dark place. The other storage environment (humidity and temperature) was the same. Those paste which were made by spinach additives become more pale in the case of day light than dark storage.



Picture 3.

The coloured pastas after drying

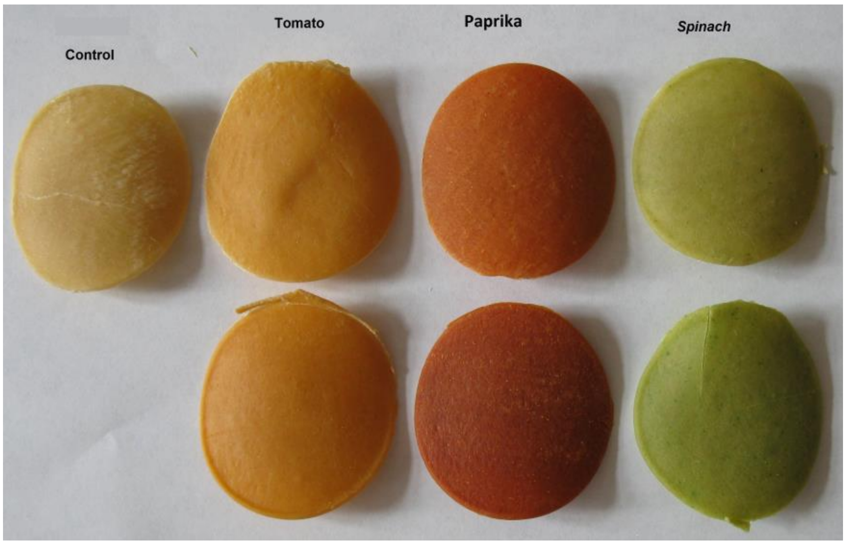
Top: 5 g additives, bottom: 10 g additives



Picture 4.

The coloured pastas after 30 days stored in daylight

Top: 5 g additives, bottom: 10 g additives



Picture 5.

The coloured pastas after 30 days stored in dark

Top: 5 g additives, bottom: 10 g additives

The spectrophotometric measurements by Micromatch^{TM} result an objective numeric data of the colours. The measurements were taken by 5 repetitions in all type of paste in every week.

The colorants of additives (tomato: lycopene, paprika: capsanthin and capsorubin, spinach: chlorophyll) have shoved very different colour changes during the 4 weeks of investigation. These changes are summarized in the Table 2. The arrows indicate the tendency, and the background colours the dimension of the CIELAB coordinates.

Table 2.

The tendencies of colour changes during the 30 days storage

CIELAB	storage	Cont	Tom 5	Tom 10	PAP 5	PAP 10	SP 5	SP 10
L	L			⇨	⇨		⇨	⇨
	D	⇦		⇨			⇦	⇦
a*	L						⇨	⇨
	D	⇦	⇦	⇦				
b*	L	⇦	⇨	⇨				⇦
	S	⇦	⇨	⇨			⇦	⇦

L daylight, D dark

It was a fact that the colouring by paprika has not changed. In the other cases there were more or less alterations of CIELAB values.

The measurements of antioxidant capacity of different components showed a ranking order. This ranking was little bit different by the methods (Table 3). The ABTS radical cation is reactive towards most antioxidants including phenols and thiols of paste. The FRAP reaction indicates the poliphenols.

The DPPH is used as an indicator of the radical nature materials and prefers the lipoids in the reaction environment.

Table 3.

The ranking of antioxidant values* of different components of paste

	ABTS		FRAP		DPPH	
1.	paprika	142,22	paprika	105,00	paprika	9,84
2.	spinach	34,44	spinach	24,58	egg	3,06
3.	tomato	33,33	tomato	20,42	tomato	1,80
4.	flour	6,67	egg	8,00	spinach	0,49
5.	egg	3,22	flour	5,00	flour	0,00

*Trolox unit

The differences among the antioxidant capacities can be explained by the basic values of additives (*Table 3.)* and the content of additives in the paste. The different storage (day light vs. dark) has also influence on the antioxidant values (*Table 4.*).

Table 4.

The antioxidant capacities of different paste by different methods in different conditions of storage

(at 4^{th} w., Trolox unit)

Rank	ABTS					
			day light		dark	
1.	paprika 10	11,811	tomato 10	7,18	paprika 5	8,73
2.	paprika 5	5,811	paprika 5	6,82	control	7,09
3.	tomato 10	4,264	spinach 5	6,27	paprika 10	5,91
4.	tomato 5	1,811	spinach 10	6,18	tomato 10	5,18
5.	spinach 10	1,434	paprika 10	5,27	spinach 5	4,55
6.	control	0,943	control	3,73	tomato 5	4,45
7.	spinach 5	0,717	tomato 5	3,73	spinach 10	3,91

Rank	FRAP					
			day light		dark	
1.	paprika 10	30	paprika 10	22,50	paprika 10	26,67
2.	paprika 5	19	paprika 5	17,50	paprika 5	18,33
3.	spinach 10	14	spinach 10	10,00	tomato 10	10,83
4.	spinach 5	13	tomato 10	10,00	spinach 10	10,00
5.	tomato 10	13	control	10,00	spinach 5	9,17
6.	tomato 5	13	tomato 5	9,17	tomato 5	8,33
7.	control	13	spinach 5	9,17	control	8,33

Conclusions

- Red and green coloured paste can be prepared by 5-10 % tomato puree or paprika powder and spinach puree due to their bioactive colour compounds lycopene, capsanthin/capsorubin and chlorophyll respectively.
- These additives increase the antioxidant capacity of paste that they have health protective effects.

Acknowledgements

The authors thank the support of Research Centre of Excellence- 17586-4/2013/TUDPOL and the project KMR_12-A 2012-0181

References

ARAB, L. , STECK, S. (2000): Lycopene and cardiovascular disease. *Am J Clin Nutr*; 71(suppl):1691S–1695S.

BENZIE, F.F., STRAIN, J.J. (1996): The ferric reducing ability of plasma (FRAP) as a measure of "antioxidant power": The FRAP assay. *Anal. Biochem*. 239: 70-76.

BLOIS M. S.(1958): Antioxidant determination by the use of a stable free radicals. *Nature*, 1958. (4617): 1198-1200.

BRITTON, G., LIAAEN-JENSEN, S., PFANDER, H. (2009): Carotenoids. Nutrition and Health. Birkhäuser Verlag, Basel, Volume 5.

CASTENMILLER, J.J.M., WEST, C.E., ET. AL. (1999) The Food Matrix of Spinach Is a Limiting Factor in Determining the Bioavailability of ß-CAROTENE and to a Lesser Extent of Lutein in Humans. *Journal of Nutr;* **129**:349-355.

DE VOGEL,J., JONKER-TERMONT, D.S.M., VAN LIESHOUT, E.M.M., KATAN,M.B., VAN DER MEER, R. (2005): Green vegetables, red meat and colon cancer: chlorophyll prevents the cytotoxic and hyperproliferative effects of haem in rat colon. *Carcinogenesis* **26:**387—393.

FELFÖLDY L. (1987): A biológiai vízminősítés (4. javított és bővített kiadás). Vízügyi Hidrobiológia 16., 1-258. - VGI, Budapest.

FERRUZZI,M.G., BLAKESLEE, J.(2007): Digestion, absorption, and cancer preventative activity of dietary chlorophyll derivatives. *Nutr. Res*.,**27:** 1– 12.

GIOVANNUCCI, E. (2002): A Review of Epidemiologic Studies of Tomatoes, Lycopene, and Prostate Cancer. *Exp.Biol. Med.,* **227**:852-859.)

HAE-YUN CHUNG ET. AL. (2004): Lutein Bioavailability Is Higher from Lutein-Enriched Eggs than from Supplements and Spinach in Men. *.J. Nutr*. **134:** 1887–1893.

KRINSKY, N.I., LANDRUM, J.T., BONE,R.A.: Biologic mechanisms of the protective role of lutein and zeaxanthin in the eye. *Ann. Rev. Nutr*., **23**: 171-201. 2003.).

OZGEN, M., REESE, N.R., TULIO, A.Z., SCHEERENS, J.C., MILLER, R. (2006): Modified 2,2-Azino-bis-3-ethylbenzothiazoline-6-sulfonic Acid (ABTS) Method to Measure Antioxidant Capacity of Selected Small Fruits and Comparison to Ferric Reducing Antioxidant Power (FRAP) and 2,2¢-Diphenyl-1-picrylhydrazyl (DPPH) Methods. *J. Agric. Food Chem*. 54, 1151-1157

RAO, A.V. (2004): Processed Tomato Products as a Source of Dietary Lycopene:Bioavailability and Antioxidant Properties**.** *Canad. J.Diet. Practice Res*., **65**: 161-165.

RODRIGEZ-AMAYA,D.B. (2001): A guide to carotenoid analysis in food, ILSI Press, Washington, D.C.

WHO/FAO (2003):Diet, Nutrition and Prevention of Chronic Diseases, 2003.