International Food Research Journal 21(3): 1187-1192 (2014)
Journal homepage: http://www.ifrj.upm.edu.my

Color, cooking properties and texture of yellow alkaline noodles enriched with millet and corn flour

[1]Ma, D. Y., [2]Zhang, J., [2]Lou, X. Y., [2]Wang, X. N., [1]Wang, C. Y. and [1*]Guo, T. C.

[1]*National Wheat Engineering Research Center, Henan Agricultural University, No. 62 Nongye Road, Zhengzhou 450002, China*
[2]*College of Food Science and Technology, Henan Agricultural University, Zhengzhou, 450002, China*

Article history

Received: 6 August 2013
Received in revised form: 2 January 2014
Accepted: 3 January 2014

Keywords

Yellow alkaline noodle
Color
Cooking property
Texture
Corn flour
Millet flour

Abstract

The objective of this study was to investigate the effect of corn flour and millet flour on color, cooking properties and texture of yellow alkaline noodle (YAN). Corn flour and millet flour were added to wheat flour at different level viz. 0, 5, 10, 20, 30% (w/w), respectively. The color, cooking properties, texture and sensory value of these sample noodles were tested. The results showed that corn flour and millet flour almost had same effect on qualities of YAN. The L^* value of fresh noodle declined slightly as the addition level of corn and millet flour were increased. The yellow index b^* value increased with addition level of corn or millet flour, maximal at 30%. The ratio of broken-down noodle, water uptake and cooking lose increased with increase in the addition level of corn and millet flour. The ratio of broken-down noodle exceeds 10% when the addition level was beyond 10% (w/w). Total sensory score and noodle adhesiveness, firmness and tensile declined as the addition level was increased. On the basis of color, textural and sensory characteristics, the addition level at 5-10% (w/w) was found to be acceptance for the preparation of corn or millet blending flour YAN.

Introduction

Flour noodles are the most widely consumed common wheat (*Triticum aestivum* L.) product in China, representing about 40 % of national wheat consumption. Chinese or cantonese style yellow alkaline noodles (YAN) dominate the Asian market and are made using simple ingredients; flour, water, a combination of alkaline salts and sodium chloride. Bright yellow color and medium to high viscoelasticity are desirable for YAN (Morris *et al*., 2000). Color is a key quality trait (Mares and Campbell, 2001) because of the visual impact at the point of sale. The yellow color of alkaline noodles is attributed to the presence of naturally occurring flavones in flour (Fortmann and Joiner, 1978). These compounds are colorless at acidic or neutral PH, but appeared yellow under alkaline ambient (Miskelly 1996; Wang *et al*., 1995). Asenstorfer *et al.* (2006) further identified four flavone-C-diglycosides that contribute to the yellow color. Some yellow pigment, such as carotenoids, also contributed to the yellowness of YAN. Hu *et al.* (2006) reported that the yellow value of YAN was significant positively correlated to flour carotenoid content. In order to achieve bright yellow color, noodle manufacturers often add pigments such as tartrazine, sunset yellow and b-carotene because there is insufficient natural pigmentation to meet customer expectations (Asenstorfer *et al*., 2006). However, customers prefer natural flour noodle.

Corn and millet are widely planted in China and its flours are very popular in human food. It was reported that corn had much higher content of phenolics, ferulic acid, and flavonoid, which have a significant antioxidant (Adom and Liu, 2002; Plate and Gallaher, 2005). Millet grains are a highly nutritious staple crop and rich in carotenoid, vitamin E, and mineral elements. Corn and millet are also rich in dietary fiber, and diets rich in fiber could reduce the risk from coronary heart disease, cancer, obesity and diabetes (Bultriss, 2008). Since corn and millet are gluten-free, its use has been primarily centered on corn batter or millet porridge. However, interest in developing alternative uses for this nutrient-rich commodity is underway. Quality characteristics of bread, steamed bread and pasta made with corn blending flour have been studied (Ugarčić-Hardi *et al*., 2006; Dimitrios and Constantina, 2009; Feng and Sun, 2013). However, to our knowledge, there are no reports about YAN made with corn or millet blending flour. As we all know, apart from the health benefit, the carotenoid pigment is yellow color and has significant positive correlation with yellowness of YAN. It is reported that millet and corn had a higher carotenoid concentrations than wheat (Xue and Michael, 2007; Liu and Lu, 2013). Hatcher *et al.* (2005) investigated the quality characteristics of YAN enriched with hull-less barley flour and reported

*Corresponding author.
Email: *xmzxmdy@126.com*

that addition of durum flour, rich naturally occurring yellow pigments, at even the 25% level would improved color characteristics (Hatcher *et al.*, 2009). The yellow b^* value of pasta has been increased by adding corn flour to common wheat flour (Ugarčić-Hardi *et al.*, 2006). The objectives of this paper were to investigate the influence of blending corn and millet flour on color and cooking properties of YAN, and provide useful information for bright yellowness and nutrient-rich noodle making.

Materials and Methods

Grain preparation and characterization of grain and flour properties

The wheat variety 'Yumai49-198' was harvest from experimental stations of Henan Agricultural University in the year 2012, and it was used as a regular raw material for the yellow alkaline noodle production. The sample was cleaned and tempered to 14.5% moisture content overnight. Milling was performed on a Brabender Junior laboratory mill based on Approved Method 26-21A (AACC, 1995). Commercial millet flour and corn flour were purchased on the local market. Wheat 'Yumai49-198' was served as both the control and as the base wheat flour to which millet and corn flours was added. Grain hardness was measured on 300-kernel samples with a Perten SKCS 4100 (Perten Instruments, Springfield, IL), following the manufacturer's instructions. Grain and flour protein contents were determined with a Kjeltec 2300 analyzer unit (Kjeltec2300, Foss, Switzerland). Dough development time (DT) and stability time (ST) were evaluated using an E-Farinograph (Brabender, Duisburg, Germany), following Approved Method AACC 54–21(AACC, 1995). Corn flour and millet flour were added to the wheat flour at the level of 5%, 10%, 20% and 30% (w/w), respectively. Sample marks are as follow: CK (100% wheat flour), CM5 (5% corn flour : 95% wheat flour), CM10 (10% corn flour : 90% wheat flour), CM20 (20% corn flour : 80% wheat flour), CM30 (30% corn flour : 70% wheat flour), MM5 (5% millet flour : 95% wheat flour), MM10 (10% millet flour : 90% wheat flour), MM20 (20% millet flour: 80% wheat flour), MM30 (30% millet flour : 70% wheat flour).

Color measurement

Noodle sheet color was measured with a chromometer (model410, Minolta Camera Co., Ltd., Osaka, Japan) with a 50 mm (diameter) measuring tube, using a white tile background. L^*, a^*, and b^* values denote lightness (white-black), red-green, and yellow-blue scales, respectively. Three color readings per noodle sheet were made at 0, 2, 4 hr. Measurements were made three times, each at a different location on the consistent (same) side of the surface of the noodle sheet. Noodle sheets were stored in plastic bags at 25°C between color readings. There were two replicate noodle sheets for each treatment.

Preparation of yellow alkaline noodle

Yellow alkaline noodles were prepared using a method similar to that of Morris *et al.* (2000), with modifications. Dough was made from 200 g of flour (14% moisture basis) by adding 0.5% (w/v) sodium carbonate, 2% sodium chloride solution, at the absorption rate of 37% in a pin mixer 4 min. Dough was rested for 1hr in a plastic bag before sheeting, then folded and sheeted three times with a 5 mm gap at 25°C. Five sheeting reductions were applied until a 1.2 mm sheet was obtained. When the reduction sheeting was completed, the color of the noodle sheet was measured with a chromometer.

Cooking properties

The properties of the cooked yellow alkaline noodle were examined. The following parameters were determined: broken rate of cooked noodles, cooking loss (%), water uptake, noodle texture and noodle sensory value. Water uptake was calculated by subtracting the initial sample weight (20 g) from the cooked sample weight and dividing by the initial sample weight. Cooking loss is defined as the mass of solids lost into the cooking water during boiling. Broken rate of cooked noodles was calculated using the number of broken noodle strand dividing by the initial sample noodle strand number.

Noodle texture

Cooked noodle texture was evaluated by texture profile analysis (TPA) using a TA-XT2 texture analyzer (Stable Micro Systems, UK) within 5 min after cooking. A set of five strands of cooked noodles was placed parallel on a flat metal plate and measured using HDP/PFS metal blade. The settings used were: Pre-Test Speed: 1.0 mm/s, Test Speed: 2.0 mm/s; Post-Test Speed: 1.0 mm/s. From the TPA force–time curve, we determined cohesiveness.

Noodle firmness

The firmness of cooked noodles was measured by using a Texture Analyzer, TA. XT2 Plus (Stable Micro Systems, UK) with a 5 kg load cell attached with a 1 mm flat Perspex knife blade. The distance between the blade and the heavy duty platform was set at 30 mm. The settings used were: Pre-Test Speed:

1.0 mm/s, Test Speed: 2.0 mm/s; Post-Test Speed: 1.0 mm/s. The cooked noodles were cut into 70 mm in length and five noodle strands were placed straight and flat adjacently to one another on the centre of heavy duty platform, with the samples positioned at right angles to the blade. The firmness value was taken from the peak of a force-time graph. Eight repeat measures were taken for each noodle formulation.

Tensile test for noodles

Tensile strength and elasticity of noodles were assessed using a Texture analyser, TA.XT2 model (Stable Micro Systems, UK) fitted with a 5 kg load cell. The distance of the probe to move apart was set at 15 mm. The settings used were: Pre-test speed: 1.0 mm/s; Test speed: 3.0 mm/s; Post-test speed: 10.0 mm/s. Ten repeat measures were taken for each noodle formulation.

Noodle score

Noodle score included colour score (weighting 10), appearance (10), firmness (20), elasticity (25), viscosity (25), smoothness (5) and taste/flavour (5). The experiment was performed at room temperature 20–25^{o}C and relative humidity 50–60%.

Statistical analysis

Data were subjected to analysis of variance (ANOVA) using SPSS (Statistical Program for Social Science) software.

Results and Discussion

Dough properties of blending flours

As shown in Table 1, dough water absorption rate decreased with increase in the addition level of corn flour, while the significant difference was only observed between CM30 and CK. As corn flour addition level was increased, dough development time decreased and the significant difference was shown between corn blending flour and CK. Compared to CK, corn blending flour decreased dough stability time, but the significant difference was only observed between CM20, CM30 and CK. The similar results were also reported by Zhang *et al.* (2012), that blending corn flour with wheat flour would change dough mixing parameters. The main reason was that corn flour free gluten could hinder the formation of gluten network (Feng and Sun, 2013). Table 2 also showed that millet flour had the same effect on dough mixing parameters. The water absorption rate, development time and stability time of millet blending flour declined as the millet flour addition level was increased. Millets also contain no gluten. So, blending millet flour with wheat flour could decrease the strength of dough.

Table 1. Dough properties of wheat flour with corn flour and millet flour supplements

Treatments	Water absorption (%)	Development time (min)	Stability time (min)	Degree of soften (FU)	Value
CK	53.2a	2.0a	2.7a	90a	39a
CM5	53.2a	1.4b	2.3ab	142a	25b
CM10	52.8ab	1.4b	2.4ab	125a	30ab
CM20	53.0ab	1.2b	1.9b	135a	19b
CM30	52.3b	1.3b	2.0b	124a	25b
CK	53.2a	2.0a	2.7a	90a	39a
MM5	53.5a	1.4b	2.2ab	140a	27ab
MM10	53.5a	1.4b	2.1ab	146a	24b
MM20	53.3a	1.4b	1.8b	149a	25b
MM30	52.5b	1.4b	1.7b	139a	27ab

a Mean value ± standard deviation (n = 2)

Yellow alkaline noodle color

Color is an important quality parameter of YAN. It results from the desirable yellow component and the undesirable brown component. The L^*, a^*, b^* value of the YAN samples with different level of corn and millet flour are presented in Table 2. The L^* is the measure of the bright from black to white. Compared to CK, corn blending flour decreased slightly noodle L^* at 0 resting time, while the significant difference was only observed between CM30 and CK. Lightness decreased dramatically between 0 and 2 hr and then continued to decline at a relative slower rate from 2 hr to 4 hr. We also noticed that the difference of L^* value between 0 and 4 hr declined with the increase of corn adding level. For example, the difference of L^* in CK and CM30 treatment between 0 and 4 hr was 4.41 and 2.84, respectively. The results indicated that noodle darkening became weaken with corn flour addition level increasing. The reason maybe is due to the PPO activity in wheat flour. It is reported that PPO activity was considered the mainly factor affecting the rate of development of undesirable dull brown and gray colors (Davies *et al.*, 2003; Jukanti *et al.*, 2003). All samples noodle sheets were slightly green (negative a^* value) and all samples exhibited fairly smooth change in a^* value between 0 and 4 hr. Regardless of no obvious regular change among theses treatments, corn blending flour had a lower a^* value than CK (apart from CM30 at 4 hr). This results also indicated that corn blending noodle had a bright yellowness (high b^* value and low a^* value). High yellow value was desirable for consumer. As presented in Table 2, the highest b^* value was observed in CM30 treatment regardless of the resting time, which indicated that adding corn flour to wheat flour would increase the yellowness of AYN. This was due to the higher carotene content of corn flour as compared to that of wheat flour. Ugarčić-Hardi *et al.* (2006) also reported that adding corn flour to wheat flour would increase pasta yellowness. The similar results were also appeared in millet blending flour. The b^* value increased dramatically with increase in

Table 2. Color parameters of YAN with corn flour and millet flour supplements

Treatments	Rest time 0 h			Rest time 2 h			Rest time 4 h		
	*L**	*a**	*b**	*L**	*a**	*b**	*L**	*a**	*b**
CK	85.22a	-1.96a	15.97e	82.43a	-2.12a	17.46c	80.81b	-1.90a	17.43c
CM5	83.93b	-2.45c	19.03c	80.39b	-2.49c	21.09b	78.83a	-2.10b	21.30b
CM10	85.09a	-2.02a	19.81c	81.96ab	-2.09a	21.07b	80.44b	-1.94ab	21.01b
CM20	84.57ab	-2.58c	24.71b	81.29ab	-2.37c	27.18a	79.84c	-2.01ab	26.72a
CM30	84.36b	-2.26b	25.71a	82.23a	-2.27b	27.91a	81.52a	-1.83a	26.68a
CK	85.22a	-1.96a	15.97e	82.43a	-2.12a	17.46c	80.81b	-1.90a	17.43c
MM5	83.39b	-2.17b	20.93c	80.64d	-2.30c	23.09b	78.70c	-2.16b	23.25b
MM10	85.19a	-2.03b	20.70c	81.87c	-2.18b	22.54b	80.29b	-2.13b	22.92b
MM20	86.01a	-2.56c	21.65b	83.62a	-2.43c	23.37b	82.72a	-2.35c	23.46b
MM30	85.26b	-2.34c	23.33a	82.54bc	-2.13b	25.60a	81.46a	-2.07ab	25.58a

a Mean value ± standard deviation (n = 6)

Table 3. Cooking properties of YAN with corn flour and millet flour supplements

Treatments	Ratio of broken-down noodle (%)	Water uptake (g/g)	Cooking lose (%)
CK	0	1.44b	8.09d
CM5	5	1.45ab	8.45cd
CM10	10	1.50ab	8.93bc
CM20	20	1.55ab	9.45ab
CM30	27.5	1.58a	9.78a
CK	0	1.44b	8.09a
MM5	3	1.47ab	9.32b
MM10	10	1.51ab	9.56b
MM20	22.5	1.59ab	9.63b
MM30	30	1.61a	12.27a

a Mean value ± standard deviation (n = 2)

the addition level of millet flour and the highest b^* was observed in MM30.

Cooking properties of YAN

Ratio of broken-down noodle after boiling, water uptake and cooking lose are the main indexs of cooking properties of YAN. As shown in Table 3, Ratio of broken-down noodle increased significantly with the addition level of corn flour or millet flour increasing, and the highest ratio was showed in treatment CM30 and MM30. It is generally accepted that ratio of broken-down noodle should not exceed 10%. In this study, only when corn flour or millet flour was below 10:100, ratio of broken-down noodle was not exceed 10%. With addition level of corn flour or millet flour increasing, water uptake increased and the highest value was showed in treatment CM30 and MM30, respectively. However, the significant difference was only observed between CK and CM30, CK and MM30. Cooking loss exhibited the same trend as water uptake with increasing corn and millet flour level. Cooking loss is undesirable and according to Wu *et al.* (1987), it should not exceed 10% of the dry weight. In this study, cooking loss of treatment MM30 is 12.27%. The CK had a low cooking loss and the blend flour had a high cooking loss. The type of ingredients in the noodle mix influences the loss of solubles and solids during cooking, and it has been reported that a compact texture of the pasta often results in less cooking loss than the loose textured pasta (Del Nobile *et al*., 2005). Fortification with non-traditional ingredients tends to weaken the gluten, which otherwise forms a strong protein-starch network (Petitot *et al*., 2010).

Sensory scores of YAN samples

Mean scores of the sensory parameters and the total quality scores are shown in Table 4. The scores of color, palate, taste and flavor had an increasing trend with the addition level of corn flour increasing. Regardless of no significant difference among all the treatment for taste& flavor, the panel members commented that the noodle with high level corn flour addition had a pleasant odor and flavor. This taste and flavor are due to the corn flour flavor. The values of appearance, elasticity, stickness, smoothness and total score declined with the ratio of corn flour addition increasing and the lowest value was observed on treatment CM30. There was no significant difference among all the treatments for appearance and elasticity. The low elasticity was due to that corn flour free gluten could hinder the formation of gluten network. The same trend was also observed on the treatment with millet flour addition, apart from the taste and flavor parameter. Regardless of no significant difference among all the treatments for taste& flavor, the panel members commented that the noodle with millet flour addition did not have a pleasant odor and flavor as corn flour.

Texture parameters of YAN samples

Adhesiveness, a measure of the stickiness of the noodle while eating was found to be the maximum (103.0) for the control YAN. The various treatments lowered the stickiness levels, and the treatment CM 30 and MM30 had the lowest value, 69.8 and 71.6, respectively. It was reported that noodle firmness was decided by the internal structures of the cooked product (Edwards *et al.*, 1993). Firmness, a measure of the toughness of cooked noodle, showed the highest value on CM5 and MM5, respectively. The value of firmness declined as the percentage of corn flour or millet flour was increased. Tensile and distance were the index of elasticity of cooked noodle. The higher value of tensile and distance means higher noodle

Table 4. Sensory scores of YAN samples

Treatments	Color	Appearance	Palate	Toughness	Stickness	Smoothness	Taste & Flavor	Total score
CK	8.2b	8.8a	17.4b	22.6a	23.0a	4.7a	4.6a	89.3a
CM5	8.3b	8.7a	17.7b	22.2a	22.7a	4.7a	4.6a	88.9ab
CM10	8.7ab	8.6a	18.1ab	21.9a	22.3a	4.5ab	4.6a	88.7ab
CM20	8.8a	8.5a	18.6a	20.8b	21.9a	4.2b	4.7a	87.6ab
CM30	8.9a	8.5a	18.8a	19.9c	21.3a	4.2b	4.8a	86.4b
CK	8.2c	8.8a	17.4a	22.6a	23.0a	4.7a	4.6a	89.3a
MM5	8.3bc	8.6ab	17.2ab	21.8ab	22.8ab	4.7a	4.6a	88.0ab
MM10	8.5abc	8.6ab	16.5abc	21.3ab	22.6ab	4.5a	4.4a	86.5ab
MM20	8.7ab	8.4ab	16.2bc	20.9ab	22.1ab	4.5a	4.4a	85.1bc
MM30	8.8a	7.9b	15.6c	20.4b	21.4b	4.5a	4.2a	82.9c

Table 5. Texture parameters of YAN samples tested by a Texture Analyzer

Treatments	Adhesiveness	Firmness (g)	Tensile (g)	Distance (mm)
CK	103.0a	44.26b	19.44a	57.76a
CM5	88.3a	55.94a	17.43b	54.43a
CM10	96.1a	48.75b	16.41b	40.01b
CM20	91.9a	42.83b	13.91c	28.30bc
CM30	69.8b	34.18c	12.85c	25.99c
CK	103.0a	44.26b	19.44a	57.7a
MM5	86.1ab	46.97a	16.11b	40.3b
MM10	98.1a	45.37ab	16.11b	34.7bc
MM20	83.5b	38.45c	12.94c	25.6c
MM30	71.6a	29.5d	10.24d	8.0d

elasticity. As shown in Table 5, tensile and distance declined with the level of corn flour or millet flour increasing, and the maximum value was observed for the control.

Conclusion

Fortification of wheat flour with corn flour and millet flour can increase the b^* value of YAN. The yellowness b^* value increased with the percentage of corn or millet flour increasing and the highest value was obtained at 30% corn flour or 30% millet flour addition. The cooking properties, such as ratio of broken-down noodle, water uptake and cooking lose increased as the addition level was increased. At the same time, total sensory score and noodle adhesiveness, firmness and tensile declined with addition of supplement increasing. The addition of corn flour and millet flour in the noodle also improves the nutritional quality, since corn flour and millet flour are rich in carotenoids and other nutrient element. Based on these results, the ratio of corn flour or millet flour at less than 10% can be used in the yellow alkaline noodle formulation to produce higher yellowness noodle, without obvious lower noodle texture and sensory value.

References

AACC. Approved Methods (9th edn). American Association of Cereal Chemists, St Paul, MN (1995).

Adom, K. K. and Liu, R. H. 2002. Antioxidant activity of grains. Journal of Agricultural and Food Chemistry 50: 6182–6187.

Asenstorfer, R. E., Wang, Y. and Mares, D. J. 2006. Chemical structure of flavonoid compounds in wheat (*Triticum aestivum* L.) flour that contribute to the yellow colour of Asian alkaline noodles. Journal of Cereal Science 43:108–119.

Buttriss, J. L. and Stokes, C. 2008. Dietary fiber and health: an overview. Nutrition Bulletin 33(3):186-200.

Davies, J. and Berzonsky, W. A. 2003. Evaluation of spring wheat quality traits and genotypes for production of Cantonese Asian noodles. Crop Science 43: 1313-1319.

Del Nobile, M. A., Baiano, A., Conte, A. and Mocci, G. 2005. Influence of protein content on the spaghetti cooking quality. Journal of Cereal Science 41:347–356.

Dimintrios, S. and Constantina, T. 2009. Effect of rice, corn and soy flour addition on characteristics of bread produced from different wheat cultivars. Food Bioprocess Technology 2(1): 68-79.

Edwards, N. M., Izydorczyk, M. S., Dexter, J. E., Biliaderis, C. G. 1993. Cooked pasta texture: comparison of dynamic viscoelastic properties to instrumental assessment of firmness. Cereal Chemistry 70:122–126.

Feng, S. D. and Sun, T. F. 2013. Effect of corn flour on textural properties of wheat dough and Chinese steamed bread. Food Science 34(1): 101-104.

Fortmann, K. L. and Joiner, R. R. 1978. Wheat pigments and flour color. Pages 493-522 in: Wheat Chemistry and Technology, 2nd ed. Y. Pomeranz, ed. American Association Cereal Chemistry: St. Paul, MN.

Hatcher, D.W., Dexter, J. E., Anderson, M. J., Bellido, G. G. and Fu, B. X. 2009. Effect of blending durum wheat flour with hard white wheat flour on the quality of yellow alkaline noodles. Food Chemistry 113: 980–988.

Hatcher,D. W., Lagasse, S., Dexter, J. E., Rossnagel, B. and Izydorczyk, M. 2005. Quality characteristics of yellow alkaline noodles enriched with hull-less barley flour. Cereal Chemistry 82(1):60–69.

Hu, R. B., Tian, J. C. and Lu, J. H. 2004. Stability analysis of carotenoid content and its coefficient correlation with yellow alkaline noodle color characteristics in common wheat (*Triticum aestivum* L.). Acta Agronomica Sinica 30(6):597-601.

Jukanti, A. K., Bruckner, P. L., Habernicht, D. K., Foster, C. R., Martin, J. M. and Fischer, A. M. 2003. Extraction and activation of wheat polyphenol oxidase

by detergents: biochemistry and applications. Cereal Chemistry 80: 712- 716.
Jun, X. and Michael N. 2007. Thermal properties of batter systems formulated by combinations of different flours. LWT - Food Science and Technology 40 (8): 1459-1465.
Liu, M. X. and Lu, P. 2013. Distribution of Vitamin E content and its correlation with agronomic traits and catotenoids content in foxtail millet varieties in China. Acta Agronomica Sinca 39(3):398-408
Mares, D. J. and Campbell, A. W. 2001. Mapping components of flour and noodle colour in Australian wheat. Australian Journal of Agricultural Research 52(12): 1297 – 1309
Miskelly, D. M. 1996. The use of alkali for noodle processing. Pages 227-273 in: Pasta and Noodle Technology. J. E. Kruger, R. B. Matsuo and J. W. Dick, eds. Am. Assoc. Cereal Chem.: St. Paul, MN
Morris, C. F., Jeffers, H. C. and Engle, D. E. 2000. Effect of processing, formula and measurement variables on alkaline noodle colors, toward an optimized laboratory system. Cereal Chemistry 77: 77- 85.
Petitot, M., Boyer, L., Minier, C. and Micard, V. 2010. Fortification of pasta with split pea and faba bean flours: Pasta processing and quality evaluation. Food Research International 43:634–641.
Plate, Y. A. and Gallaher, D. D. 2005. The potential health benefits of corn components and products. Cereal Foods World 50: 305-314.
Ugarčić-Hardi, Ž., Jukić, M., KoMleNić, D. D., Sabo, M. and Hardi, J. 2006. Quality parameters of noodles made with various supplements. Czech Journal of Food Science 25(3): 151-157.
Wang, Y., and Mares, D. J. 1995. Characterisation of grain constituents responsible for the yellow colour of Asian alkaline noodles. Pages 380-382 in: Proc. 45th Aust. Cereal Chem. Conf. Y. A. Williams and C. W. Wrigley, eds. Royal Australian Chem. Inst.: North Melbourne, Victoria, Australia.
Wu Y.V., Youngs, V. L., Warner, K. and Bookwalter, G. N. 1987. Evaluation of spaghetti supplemented with distillers' dried grains. Cereal Chemistry 64: 434-436.