Spatial distribution patterns of protein components and quality traits of flours from different pearling fractions of wheat grains as affected by nitrogen topdressing timing

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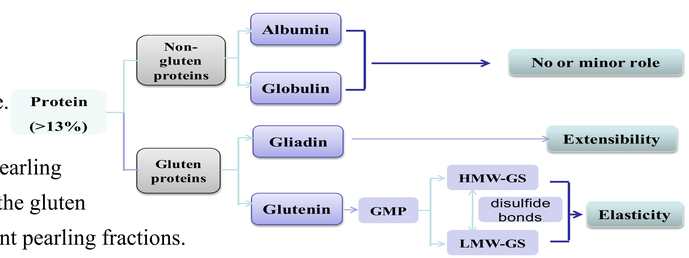
Introduction

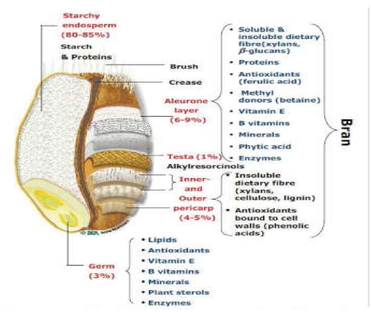
Wheat is one of the crucial source of food in the world, contributing to over 45% of the global food supply and over 40% of the global protein supply over the past decade.



The content of nutritional material differs in different pearling fractions of wheat grains . However, little is known about the gluten distribution as well as the quality of bread made by different pearling fractions.

Nitrogen is the most important cultivated factor affecting yield and quality of wheat, including protein content and composition. However, little attention has been done on effects of nitrogen topdressing stage on spatial distribution of gluten proteins.

In this study, two cultivars of medium gluten were used to evaluate yield and quality after treating by nitrogen topdressing at different stage. Mature grains were pearled into nine fractions to further study the distribution of protein and its components as well as its response to nitrogen topdressing stage. We aim to reveal effects of nitrogen topdressing stage on spatial distribution of gluten proteins.



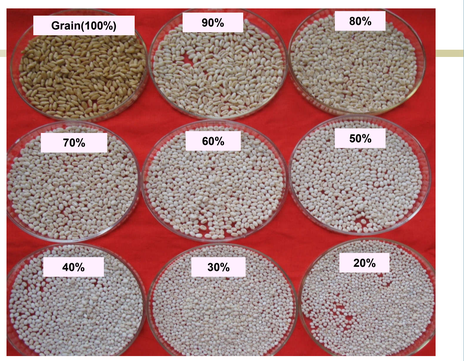
Wheat grain with different anatomical components and the distribution of the bio-active compounds(Surget and Barron, 2005)

Materials and methods

Table 1 Treatment design and nitrogen topdressing protocols

Cultivar	Treatment	Growth stage of topdressing	Topdressing Date		Nitrogen rate (kg/acre)		
			2013-2014	2014-2015	B	T	Total
YM 16	TE5	Top fifth leaf	3.5	3.11	8	8	16
	TE3	Top third leaf	3.21	3.26	8	8	16
	TE1	Top first leaf	3.31	4.4	8	8	16
ZM 895	TE5	Top fifth leaf	2.25	2.28	8	8	16
	TE3	Top third leaf	3.20	3.31	8	8	16
	TE1	Top first leaf	4.15	4.24	8	8	16

Note: B and T represented basal nitrogen and topdressing nitrogen, respectively



Results & Discussion

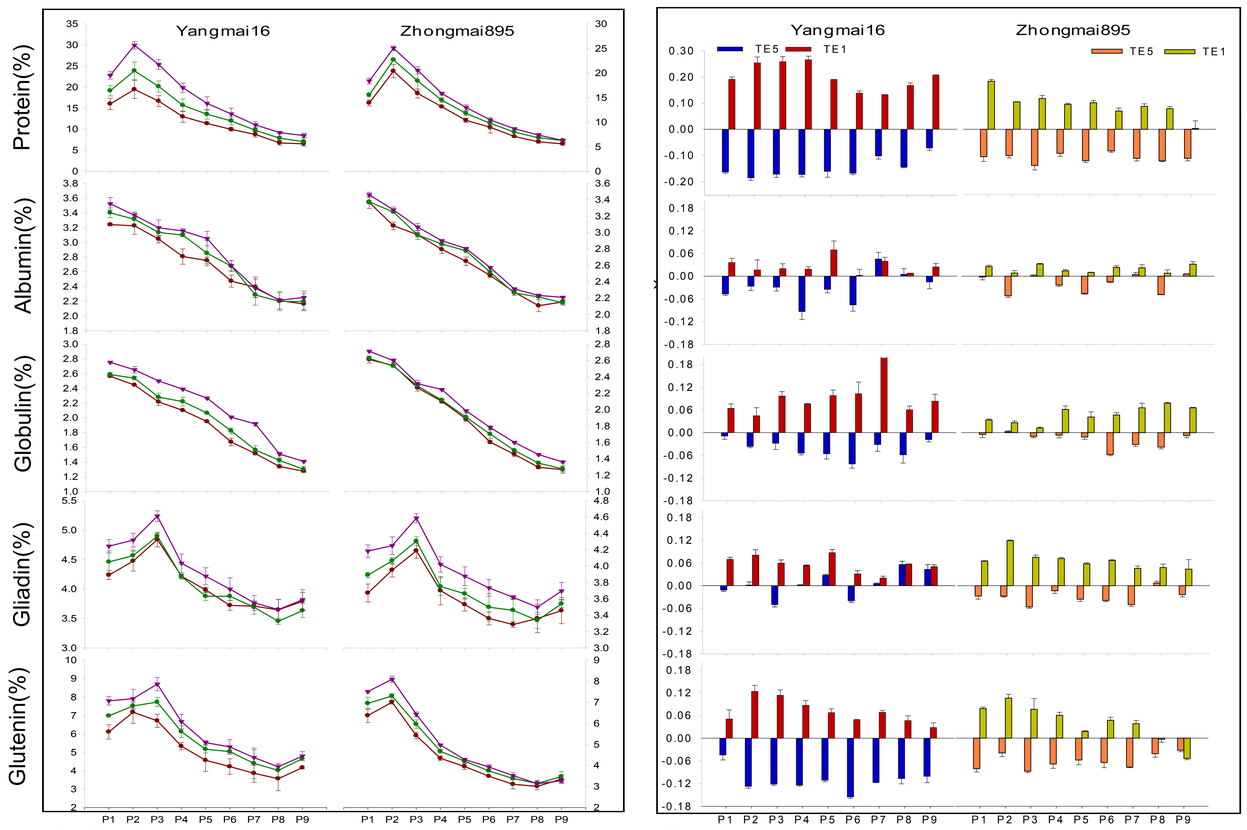


Fig. 1 Effect (left) and responses (right) of nitrogen topdressing at different leaf age on distribution of protein and its components content in different pearling fractions of two cultivars.

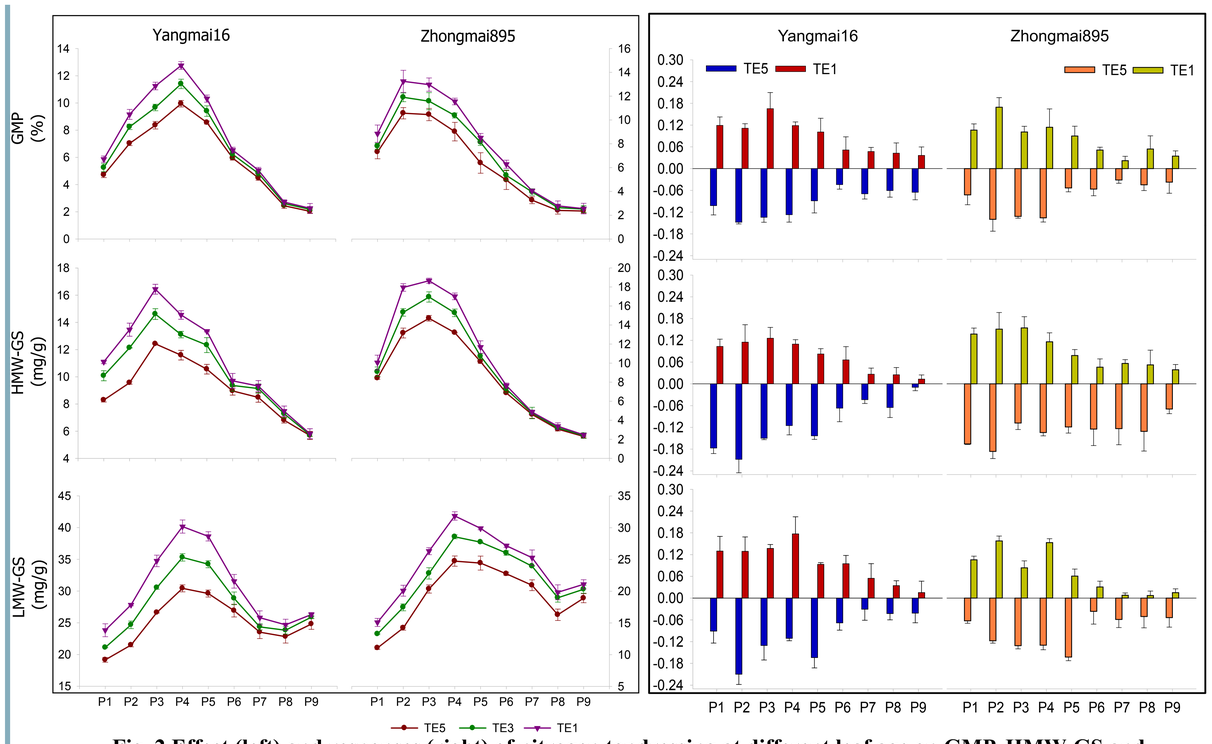


Fig. 2 Effect (left) and responses (right) of nitrogen topdressing at different leaf age on GMP, HMW-GS and LMW-GS content in different pearling fractions of two cultivars

Table 2 Effect of nitrogen topdressing at different leaf age on gluten content in different pearling factions (2014-2015)

Cultivar	Treatment		Pearling							
			2	3	4	5	6	7	8	9
YM16	Wet gluten (g/10g)	TE5	1.84^{c}	3.16^{b}	3.07^{b}	2.37^{c}	2.17^{a}	2.23^{a}	1.92^{b}	1.69^{c}
		TE3	3.66^{b}	3.40^{b}	3.26^{b}	3.17^{b}	2.53^{a}	2.33^{a}	1.93^{b}	2.04^{b}
		TE1	4.65^{a}	4.21^{a}	3.47^{a}	3.49^{a}	2.63^{a}	2.40^{a}	2.39^{a}	2.41^{a}
	Dry gluten (g/10g)	TE5	0.64^{b}	1.15^{b}	1.22^{a}	1.00^{a}	0.79^{a}	0.74^{a}	0.72^{b}	0.64^{a}
		TE3	1.31^{ab}	1.21^{b}	1.22^{a}	1.13^{a}	0.90^{a}	0.77^{a}	0.76^{b}	0.76^{a}
		TE1	1.67^{a}	1.57^{a}	1.25^{a}	1.26^{a}	1.01^{a}	0.86^{a}	0.91^{a}	0.87^{a}
	Gluten index	TE5	0.94^{a}	0.96^{a}	0.95^{a}	0.97^{a}	0.94^{a}	0.95^{a}	0.98^{a}	0.97^{a}
		TE3	0.95^{a}	0.94^{ab}	0.92^{a}	0.90^{b}	0.93^{a}	0.94^{a}	0.91^{a}	0.92^{b}
		TE1	0.94^{a}	0.90^{b}	0.91^{a}	0.90^{b}	0.87^{b}	0.82^{b}	0.80^{b}	0.82^{c}
ZM895	Wet gluten (g/10g)	TE5	3.38^{a}	3.40^{b}	3.00^{a}	2.83^{a}	2.46^{b}	1.66^{b}	0.99^{b}	1.98^{b}
		TE3	3.65^{a}	3.80^{ab}	3.32^{a}	3.10^{a}	2.63^{ab}	1.91^{ab}	1.43^{ab}	2.37^{ab}
		TE1	3.66^{a}	4.05^{a}	3.44^{a}	3.43^{a}	3.03^{a}	2.50^{a}	1.68^{a}	2.71^{a}
	Dry gluten (g/10g)	TE5	1.06^{b}	1.01^{b}	0.98^{a}	0.95^{a}	0.86^{a}	0.60^{b}	0.40^{a}	0.66^{a}
		TE3	1.12^{b}	1.27^{b}	1.07^{a}	1.04^{a}	0.89^{a}	0.62^{b}	0.46^{a}	0.81^{a}
		TE1	1.24^{a}	1.33^{a}	1.19^{a}	1.13^{a}	1.09^{a}	0.89^{a}	0.51^{a}	0.87^{a}
	Gluten index	TE5	0.98^{a}	0.94^{a}	0.87^{a}	0.79^{a}	0.84^{a}	0.80^{a}	0.86^{a}	0.78^{a}
		TE3	0.96^{a}	0.88^{a}	0.82^{a}	0.78^{a}	0.80^{a}	0.80^{a}	0.85^{a}	0.73^{b}
		TE1	0.91^{b}	0.90^{a}	0.82^{a}	0.71^{a}	0.69^{b}	0.78^{a}	0.82^{a}	0.72^{b}

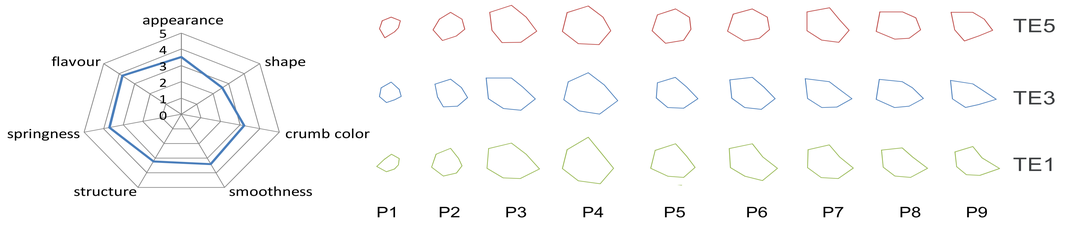


Fig 3 Baking performance of bread made of different pearling fractions of wheat grain

Conclusions

- The content of gliadin, glutenin as well as gluten presented unimodel curve peaking at P2 or P3..
- Delaying nitrogen topdressing could increased content of gluten protein and gluten in each fractions, especially for aleurone layer and outer endosperm.
- TE1 increased volume, sensory score as well as TPA indexes significantly and bread made by P3 and P4 showed best baking quality comparing with other fractions..