Study on the changes of deoxynivalenol content in wheat flour processed by different methods

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Abstract

Through comparing effects of different techniques on the deoxynivalenol (DON) content in different parts of wheat, we obtained the following results: 1. DON is mainly distributed near the epidermis of wheat, the amount of DON in wheat flour is lower than it in whole wheat meal. 2. Cleaning wheat prior to milling decreases DON content. 3. Flour and bran from different milling lines have similar DON content. 4. When the DON content of whole wheat meal is below 1.56mg/kg, there is a high probability that we can decrease DON content to 1mg/kg by cleaning, washing and milling.

Keywords: wheat, deoxynivalenol(DON), processing methods, decrease the content

1. Introduction

Deoxynivalenol (DON), also known as vomitoxin, is atrichothecene compound and a secondary metabolite of Fusarium. DON is an inhibitor of protein synthesis in vivo. DON can cause anorexia, vomiting, diarrhea, fever, severe damage to the hematopoietic system, and even cause to humans and animals. Simultaneously, the risks of DON include teratogenic, mutagenic, and carcinogenic effects. [2-5] Because of these risks, the DON content in cereals and foods cannot exceed 1.0mg/kg in China. The aim of this study was to examine DON transference in the wheat production chain.

2. Material and Methods

We sampled wheat from six granaries (25 kg per sample) from the Anhui Province. The HPLC was a Agilent model 1260, with a UV detector; electronic balance: Mettler Toledo MS104S type, a sense of the amount of 0.0001g. The mill machine was a FOSS1093 and the wheat sifting machine was a JJZY type impurity detector for grain made in Sino Grain of Chengdu institute. A model JMFB70X30 wheat mill made at the Sino Grain of Chengdu was used, the oven was a model DHG9082 electric oven, the homogenizer was a model IKA T18 D S2.

The list of reagents is as follows: chromatographically grade; acetonitrile: chromatographically grade; water: UPW; polyethylene glycol: AR, relative molecular mass of 8000; NaCl: AR; disodium hydrogen phosphate: AR; potassium dihydrogen phosphate: Analysis pure; KCl: AR; deoxynivalenol standards: Sigma, purity ≥98%; immunoaffinity column: Pribolab; glass fiber filter: diameter 11cm, aperture 1.5μm.

Sampling was done in accordance with GB/T5491-1985 and the samples prepared in accordance with GB/T5491-1985. Samples were mill and sifted, moisture was analyzed in accordance with GB/ T5497-1985. DON detection was done accordance with GB/T23503-2009.

Samples were mixed and separated, impurities were removed, and divided into four lots of 550 g each. One lot was not sifted or washed but not sifted, the third was sifted and not

washed, and the last lot was washed and sifted. Each sample was divided into 60-70 g, and pulverized to obtain whole-wheat flour.

3. Results and Discussion

3.1. The proportion of wheat flour products

DON content is shown in Table 1.

Table 1 DON content of each component in treatments.

No.	Conditions	Whole-wheat flour (mg/kg)	Core powder (mg/kg)	Skin powder (mg/kg)	Rough bran (mg/kg)	Fine bran (mg/kg)
1	sift（×） washing（×）	3.18	2.86	2.94	3.92	3.95
	sift（×） washing（√）	2.79	2.61	2.75	3.32	3.19
	sift（√） washing（×）	2.66	2.35	2.49	3.63	3.80
	sift（√） washing（√）	2.33	2.28	2.16	2.94	2.82
2	sift（×） washing（×）	2.77	2.35	2.39	3.67	3.81
	sift（×） washing（√）	2.41	2.17	2.18	3.04	3.03
	sift（√） washing（×）	2.33	1.91	2.08	3.46	3.63
	sift（√） washing（√）	2.08	1.86	1.91	2.81	2.77
3	sift（×） washing（×）	2.38	1.94	2.02	3.29	3.18
	sift（×） washing（√）	2.16	1.9	1.86	2.91	2.90
	sift（√） washing（×）	2.19	1.76	1.76	3.07	3.21
	sift（√） washing（√）	2.23	1.85	1.88	2.74	2.61

Table 1 (Con.).

No.	Conditions	Whole-wheat flour (mg/kg)	Core powder (mg/kg)	Skin powder (mg/kg)	Rough bran (mg/kg)	Fine bran (mg/kg)
4	sift（×） washing（×）	1.85	1.46	1.52	2.75	2.66
	sift（×） washing（√）	1.61	1.32	1.34	2.40	2.20
	sift（√） washing（×）	1.58	1.25	1.33	2.54	2.58
	sift（√） washing（√）	1.45	1.08	1.13	2.11	2.18
5	sift（×） washing（×）	1.32	0.85	0.87	2.34	2.25
	sift（×） washing（√）	1.07	0.81	0.88	1.57	1.64
	sift（√） washing（×）	1.20	0.89	0.85	2.16	2.07
	sift（√） washing（√）	1.01	0.79	0.83	1.38	1.45
6	sift（×） washing（×）	1.04	0.66	0.71	1.93	1.82
	sift（×） washing（√）	0.88	0.67	0.66	1.24	1.31
	sift（√） washing（×）	0.99	0.69	0.73	1.76	1.65
	sift（√） washing（√）	0.81	0.64	0.59	1.06	1.14

DON was separated in wheat bran. The proportion of DON content in total bran and total flour is shown in Table 4.

Table 4 Proportion of DON content in total bran and total flour.

No.	The DON proportion in whole-wheat（mg/kg）	The DON proportion in bran（%）	The DON proportion in flour（%）
1	3.18	0.36	0.64
2	2.77	0.42	0.58
3	2.38	0.40	0.60
4	1.85	0.44	0.56
5	1.32	0.53	0.47
6	1.04	0.54	0.46

DON content in the flour positively correlation while the DON content proportion in bran with whole-wheat flour was negatively correlated (Figs. 1 and 2). This trend appears likely to be due to a large number of wheat seeds DON.

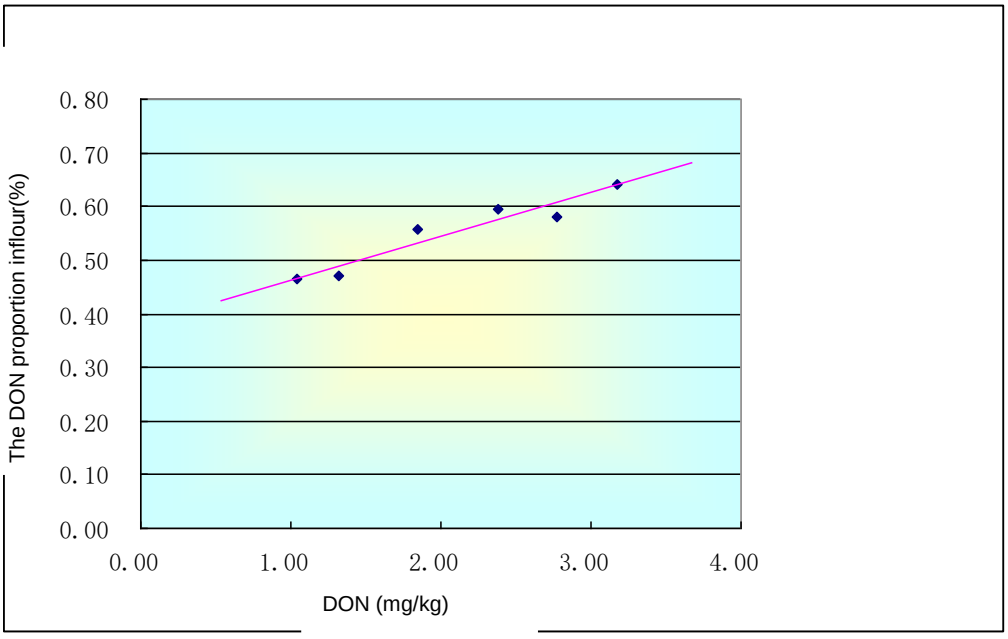

Figure 1 DON proportion in flour (%).

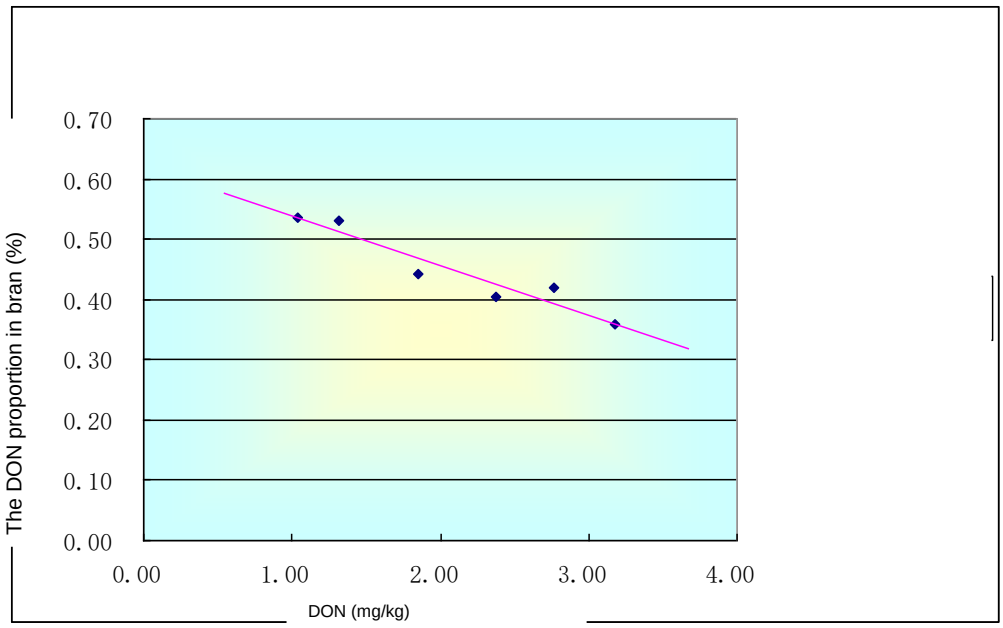

Figure 2 The DON proportion inbran (%).

As can be seen from Table 3, sifting and washing can reduce DON content in varying degrees in wheat flour.

Table 3 The DON content reduction in the different conditions wheat.

No.	Conditions	DON reduction in whole-wheat flour（%）	DON reduction in core powder（%）	DON reduction in skin powder（%）	DON reduction in rough bran（%）	DON reduction in fine bran（%）
1	sift（×） wash（×）	0.0	0.0	0.0	0.0	0.0
	sift（×） wash（√）	12.2	8.7	6.5	15.3	19.2
	sift（√） wash（×）	16.4	17.8	15.3	7.4	3.8
	sift（√） wash（√）	26.7	20.3	26.5	25.0	28.6

Table 3 (Con.).

No.	Conditions	DON reduction in whole-wheat flour（%）	DON reduction in core powder（%）	DON reduction in skin powder（%）	DON reduction in rough bran（%）	DON reduction in fine bran（%）
2	sift（×） wash（×）	0.0	0.0	0.0	0.0	0.0
	sift（×） wash（√）	13.0	7.7	8.8	17.2	20.5
	sift（√） wash（×）	15.9	18.7	13.0	5.7	4.7
	sift（√） wash（√）	24.9	20.9	20.1	23.4	27.3
3	sift（×） wash（×）	0.0	0.0	0.0	0.0	0.0
	sift（×） wash（√）	9.2	2.1	7.9	11.6	8.8
	sift（√） wash（×）	8.0	9.3	12.9	6.7	-0.9
	sift（√） wash（√）	6.3	4.6	6.9	16.7	17.9
4	sift（×） wash（×）	0.0	0.0	0.0	0.0	0.0
	sift（×） wash（√）	13.0	9.6	11.8	12.7	17.3
	sift（√） wash（×）	14.6	14.4	12.5	7.6	3.0
	sift（√） wash（√）	21.6	26.0	25.7	23.3	18.0

Table 3 (Con.).

No.	Conditions	DON reduction in whole-wheat flour（%）	DON reduction in core powder（%）	DON reduction in skin powder（%）	DON reduction in rough bran（%）	DON reduction in fine bran（%）
5	sift（×） wash（×）	0.0	0.0	0.0	0.0	0.0
	sift（×） wash（√）	18.9	4.7	-1.1	32.9	27.1
	sift（√） wash（×）	9.1	-4.7	2.3	7.7	8.0
	sift（√） wash（√）	23.5	7.1	4.6	41.0	35.6
6	sift（×） wash（×）	0.0	0.0	0.0	0.0	0.0
	sift（×） wash（√）	15.4	-1.5	7.0	35.8	28.0
	sift（√） wash（×）	4.8	-4.5	-2.8	8.8	9.3
	sift（√） wash（√）	22.1	3.0	16.9	45.1	37.4

DON trend in processed flour is in Fig. 3.

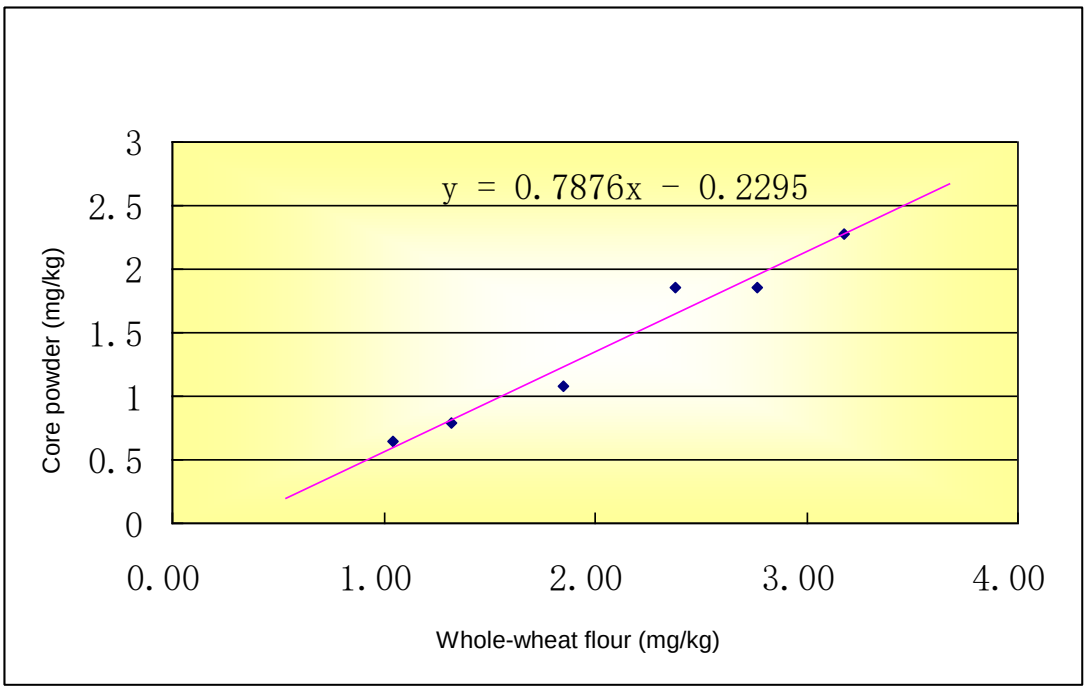

Figure 3 DON trend in processed flour.

When DON content in wheat is under 1.56mg/kg, DON content in processed flour is less than 1mg/kg; however, when the DON content wheatexceeds 1.56 mg/kg, DON content of processed flour is probably more than1mg/kg.Sifting and washing can reduce DON content in in wheat flour. Combining these two processes will help reduce DON content.