Study on Breeding for Crop Fine Varieties Rich in Food Factors and Their Functions

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ABSTRACT

Thirty-one crop fine varieties rich in twenty-eight factors were bred, respectively. The contents of the factors were from 1.47 to 16.57 times of the corresponding commercial varieties. Animal experiments were conducted on the seven fine varieties. The effects of the factors from the fine varieties including the high anthocyanin black rice, high polysaccharides tea, high polysaccharides Agaricus blazei, high polysaccharides Grifola frondosa, and high DHEA yam, were significantly better than those from the commercial varieties at equal weight. The effects of proanthocyanidin from the two fine grape varieties were significantly better than those from the commercial varieties at equal PC dose.

Key words: factor, crop, variety

INTRODUCTION

The raw materials for the development and manufacture of health foods are generally from the agricultural product market. The varieties with high yield are frequently preferred for profit maximization. However, there are many varieties for a crop and the factors are different in content. It is highly necessary to breed or screen fine varieties rich in factors from the crop germplasms, which may play an important role in improving the effect of functional foods. We have focused on the genetic breeding of crop quality for many years, bred thirty-one fine varieties with twenty-eight factors (Table 1). The effects of factors of the seven fine varieties were studied.

MATERIALS AND METHODS

The crop varieties were from the National Crop Germplasms Bank of China, the International Rice Research Institute and the Agricultural Product Quality Institute of FAFU.

The factors (Table 2 - 5) were extracted from the equal weight of the fine varieties and the commercial varieties, respectively. Animal experiments of the factors were conducted as in references[1-3]. The PC extracts obtained from the fine grape variety and the commercial variety were prepared to equal dose for animal experiment[3,4].

RESULTS AND DISCUSSION

I. *The Breeding and Screening of the Crop Fine Varieties Rich in Factors (Table 1)*

The contents of factors from fine varieties were greater than those of controls. In particular, we screened the rice variety and corn variety containing melatonin, whereas there was no melatonin in the commercial cultivars.

II. The Effects of Factors of Fine Varieties Compared with Commercial Varieties at Equal Weight (Table 2-5)

The effects of factors extracted from the fine varieties were higher than those extracted from the commercial varieties at equal weight. For instance, the blood glucose concentration of hyperglycemic mice tested with fine tea variety was 57.51% lower than with the commercial variety (Table 3).

III. *The Effect of Grape Proanthocyanidin on the MDA Content of the Fruit Fly at Equal Dose (Table 6)*

The MDA contents of the fruit fly at equal dose of proanthocyanidin (0.20%) from the fine variety and commercial variety were determined. The MDA contents

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Table 1. The crop fine varieties rich in factors

No	Crop	Factor	Unit	Commercial content	Fine variety		Comparison of factor content
					Variety	Content	
1	black rice (brown)	total flavones	mg/g	1.12	FZ1033	2.34	1 : 2.09
2	black rice (brown)	anthocyanin		11.85	9A721	30.719	1 : 2.59
3	rice(brown)	GABA	mg/g	1.86	I-332	5.91	1 : 3.18
4	rice(brown)	coenzyme Q_{10}	mg/g	0.5	B236	2.70	1 : 5.40
5	rice(bran)	oryzanol	%	1.980	JHZZ	4.158	1 : 2.10
6	rice (bran)	calcium	mg/kg	190.92	XK-2	523.13	1 : 2.74
	rice (milled)			39.41		95.38	1 : 2.42
7	rice(bran)	iron	mg/kg	41.73	LHDHY	83.46	1 : 2.00
8	rice(milled)			3.18	TJ1032	9.93	1 : 3.12
9	rice(brown)	melatonin	ng/g	0	MK-22	264	0 : 264
10	corn	melatonin	ng/g	0	JHN	2034	0 : 2034
11	broccoli	sulforaphane	μg/g	104.15	FU-1	984.47	1 : 9.45
12	broad bean (flower)	L-dopa	%	6.949	C001	10.181	1 : 1.47
13	soy bean	isoflavone	μg/gFW	9.97	TN-2	51.96	1 : 5.21
14	tea	EGCG	%	7.90	BD-4	16.80	1 : 2.13
15	tea	polysaccharide	%	1.92	OTV08	5.62	1 : 2.93
16	white tea	theanine	%	0.95	WT03	2.27	1 : 2.38
17	sweet potato	beta-carotene	mg/g	0.038	YS-5	0.090	1 : 2.37
18	sweet potato	DHEA	μg/100g	295.84	SP1	752.98	1 : 2.55
19	yam	DHEA	mg/100g	3.68	WK-3	8.15	1 : 2.22
20	grape(peel)	resveratrol	μg/g	1.877	GQ	31.094	1 : 16.57
21	grape(peel)	proanthocyanidin	%	1.18	HJF	8.90	1 : 7.54
22	grape(seed)	proanthocyanidin	%	4.77	HM	21.27	1 : 4.46
23	longan (pulp)	polysaccharide	mg/gFW	1.64	GHW	5.787	1 : 3.53
24	longan (seed)	polysaccharide	mg/gFW	5.49	PD4	51.269	1 : 9.34
25	A. blazei (fermentation)	polysaccharide	mg/mL	0.61	AB01	2.05	1 : 3.36
26	G. frondosa (fermentation)	polysaccharide	mg/mL	0.65	GF06	1.65	1 : 2.54
27	G. ganoderma	polysaccharide	%	0.74	YZ	6.69	1 : 9.04
28	lotus seed	total flavones	mg/kg	167.0	GCTKL	664.00	1 : 3.98
29	lotus seed	polysaccharide	mg/kg	5.16	JNHPL	13.32	1 : 2.58
30	vine tea	total flavones	mg/gGW	129.0	JH	453.90	1 : 3.52
31	G. pentaphylla	saponin	%	5.0	G8	9.65	1 : 1.93

Table 2. T-AOC and SOD of the blood serum and liver of mice treated with fine black rice variety with high anthocyanin

Variety	Anthocyanin content (colourity)	Anthocyanin dose (mg/kg•d)	Serum				Liver			
			T-AOC (u/mL)	α	SOD (u/mL)	α	T-AOC (u/mgprot)	α	SOD (u/mgprot)	α
CK	—	0	6.742 ± 0.11	cC	117.03 ± 2.00	cC	1.416 ± 0.06	bB	90.73 ± 1.23	cC
commercial RBQ	4.41	50	7.473 ± 0.19	bB	146.58 ± 1.24	bB	1.407 ± 0.02	bB	109.14 ± 1.81	bB
fine N84	19.08	200	9.395 ± 0.06	aA	231.40 ± 3.00	aA	2.035 ± 0.08	aA	126.09 ± 3.08	aA
increase%	—	—	25.72%	—	57.87%	—	44.63%	—	15.53%	—

Note: The CK stands for control group and the α stands for level of significance. Lower case letter indicates $p < 0.05$ and upper case letter indicates $p < 0.01$.

Table 3. The blood glucose of hyperglycemic mice treated with fine tea variety with high polysaccharides content

Variety	Tea polysaccharide content	Tea polysaccharide dose (mg/kg/d)	blood glucose prior to treatment (mmol/L)	blood glucose after treatment (mmol/L)	decrease rate of blood glucose	level of significance
normal CK	—	0	5.10 ± 1.00	5.21 ± 1.10	—	—
hyperglycemic CK	—	0	16.94 ± 3.54	17.05 ± 3.85	—	—
commercial OTV61	3.65%	138.02	16.80 ± 3.00	12.83 ± 3.62**	23.63%	aA
fine OTV08	5.62%	161.74	16.74 ± 3.62	10.51 ± 3.30**	37.22%	bB
decrease%	—	—	—	—	57.51%	—

Note: The CK stands for control group. The "*" indicates $p < 0.05$ in comparison with the hyperglycemic CK and the "**" indicates $p < 0.01$, in comparison with the hyperglycemic CK.

Table 4. Effects of polysaccharides from Agaricus blazei and Grifola frondosa on S_{180} tumor growth in vivo

Group	Polysaccharides content (mg/mL)	Polysaccharides dose (mg/kg•d)	Mice quantity		Mice weight gain (g)	Mean weight of tumor (mg)	Tumor inhibition rate	Level of significance
			prior to treatment	after treatment				
tumor CK	—	0	8	7	7.6 ± 0.42	1.83 ± 0.25	—	—
cyclophosphamide	—	20	8	8	4.3 ± 0.66 **	0.77 ± 0.11**	57.92%	aA
commercial A. blazei AB03-P	0.61	100	8	8	7.1 ± 0.49	1.44 ± 0.23*	21.31%	dD
fine A. blazei AB01-P	2.05	200	8	8	7.4 ± 0.41	1.00 ± 0.13**	45.36%	bB
percent of increase	—	—	—	—	—	—	112.86%	—
commercial G. frondosa GF03-P	0.22	50	8	8	7.0 ± 1.03	1.53 ± 0.35	16.39%	eE
fine G. frondosa GF06-P	1.65	200	8	8	7.5 ± 0.80	1.06 ± 0.29**	42.08%	cC
percent of increase	—	—	—	—	—	—	156.74%	—

Note: The CK stands for control group. The "*" indicates $p < 0.05$ and the "**" indicates $p < 0.01$, in comparison with the control.

Table 5. The SOD activity of fruit fly treated with fine yam variety with high DHEA content

Group	DHEA content (mg/100g)	DHEA concentration for treatment	Male fruit fly			Female fruit fly		
			SOD activity (U/mg)	increase rate of SOD	α	SOD activity (U/mg)	increase rate of SOD	α
CK	—	0	3.83 ± 0.15	—	—	3.36 ± 0.12	—	—
commercial variety JXSS	2.88	0.001%	3.83 ± 0.05	0.00%	bB	3.47 ± 0.07	3.17%	bB
fine variety WK-3	8.15	0.003%	4.21 ± 0.10**	9.85%	aA	3.72 ± 0.04**	10.62%	aA
percent of increase	—	—	—		—	—	235.02%	—

Note: The CK stands for the control. The α stands for level of significance. The "*" indicates $p < 0.05$ and the "**" indicates $p < 0.01$, in comparison with the control.

Table 6. The MDA content of fruit fly treated with fine grape variety with high proanthocyanidin (PC) content

Group	PC content	concentration in the media	MDA（nmol/mL）		rate of MDA decrease			
			female	male	femal	α	male	α
CK	—	0	2.20 ± 0.05	2.25 ± 0.10	—	—	—	—
commercial BC (seed)	7.64%	0.20%	1.93 ± 0.14**	2.02 ± 0.06**	12.35%	cC	9.98%	cC
fine WDLY (seed)	22.28%	0.20%	1.76 ± 0.04**	1.81 ± 0.03**	20.01%	aA	19.25%	aA
rate of decrease	—	—	—	—	62.02%	—	92.89%	—
commercial HR (peel)	0.82%	0.20%	2.06 ± 0.06	2.13 ± 0.09	6.40%	dD	5.22%	dD
fine HMG (peel)	11.34%	0.20%	1.82 ± 0.10**	1.89 ± 0.05**	14.96%	bB	15.73%	bB
rate of decrease	—	—	—	—	133.75%	—	201.34%	—

Note: The CK stands for the control. The α stands for level of significance. The "*" indicates $p < 0.05$ and the "**" indicates $p < 0.01$, in comparison with the control.

were significantly lower for the seed and peel of fine grape variety than those of commercial variety. Our results showed that the antioxidation effect of the fine variety was greater than the commercial variety.

CONCLUSIONS

A crop showed great variance in the factors from one variety to another. The thirty-one varieties bred or screened in our study had content of factors ranging from 1.47 times to 16.57 times of the corresponding commercial varieties.

Fine varieties containing black rice anthocyanin, tea polysaccharides, A. blazei polysaccharides, G. frondosa polysaccharides, high yam DHEA, respectively, had significantly better effects compared to the corresponding commercial varieties at equal weight.

The effect of PC from the grape fine variety was significantly higher than that from the commercial variety at equal PC dose.

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