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Changes of Sesamin and Sesamolin Contents of Sesame Seeds during Grain Filling in Different Sowing Dates

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ABSTRCAT : To obtain some information on the change of antioxidant components of seeds during grain filling stage as affected by the sowing dates, lignan compounds were investigated according to days of flowering under different sowing dates. Sesamin and sesamolin contents showed significantly different by days of flowering and varieties. Both of sesamin and sesamolin content increased after flowering and reached highest at 40 days of flowering, but they started to decrease thereafter. Sesamin and sesamolin contents of sesame seeds changed with sowing dates. Generally, late sowing date of May 30 showed relatively higher accumulation rate of sesamin and sesamolin contents rather than other sowing dates, but overall patterns were a little different by varieties and lignan compounds. In Yangbaekkae, sesamin and sesamolin contents showed relatively higher at sowing date of May 30, but Yanghuckkae showed higher sesamin and sesamolin contents till 20 days of flowering when sowing date of May 30, but it showed to change that both lignan contents were relatively higher under sowing date of May 10.

Keywords: sesame, lignan, sesamin, sesamolin, sowing date, days of flowering

Sesame (*Sesamum indicum* L.) seeds contain about 50% of lipid, 25% of protein and less than 1% of lignan compounds. Sesamin is a major lignan in sesame seed, and its biological effects have been extensively studied. Sesamolin and sesaminol glucoside have own individual antioxidative activities which are related to their high stability against oxidation and increased storage of sesame oil (Fukuda *et al.*, 1986). Many reports said that lignan compounds in sesame seed depend on environmental factors such as temperature and day length, varieties and capsule position in plant (Lee *et al.*, 1993; Ryu *et al.*, 1993). Maturity of individual capsule is not uniform in sesame crop because sesame has indeterminate flowering habit. Exact evaluation as well as accumulated patterns of sesamin and sesamolin contents of sesame seeds is necessary to breed lignan-rich sesame varieties which will foster sesame consumption in domestic market and intensify international competition in world sesame market. Therefore, it is necessary to study accurate maturity stages to examine varietal difference of lignan contents.

MATERIALS AND METHODS

Plant materials and methods

Two sesame varieties, Yangbaekkae and Yanghuckkae were used for experimental materials. Total four times of sowing dates from April 20 to June 10 were established at the National Institute of Crop Science, Suwon, in 2002. Figure 1 showed meteorological conditions in year of 2002. Rainfall distribution pattern was one of the most important factors to determine sesame growth and yield potential. Accumulated temperature was 772°C. Total amount of precipitation recorded about 1648 mm. Enough soil water provided to the young plant during early vegetative growth stage.

A randomized complete block design with three replications was used for this experiment. Spacing between plants was 10cm and row spacing was 30cm in a 70cm wide black polyethylene film mulching bed. Days after flowering from one of buds in plant were bursting to the days of evaluate lignan content of sesame seeds. Total five capsules per plant at four evaluation stages of days after flowering were tagged and shattered sesame seeds to analyzes lignan contents. Sesame seeds were smashed and extracted using n-hexane and determined sesanin and sesamolin contents under operation condition of HPLC analysis (Table 1).

Statistical analysis

Variances for sesamin and sesamolin contents according to sowing dates, varieties and day after flowering of sesame were analyzed. Significant difference level depending on the mean value of sesamin and sesamolin content at the several days of flowering was determined by Duncan's Multiple Range Test.

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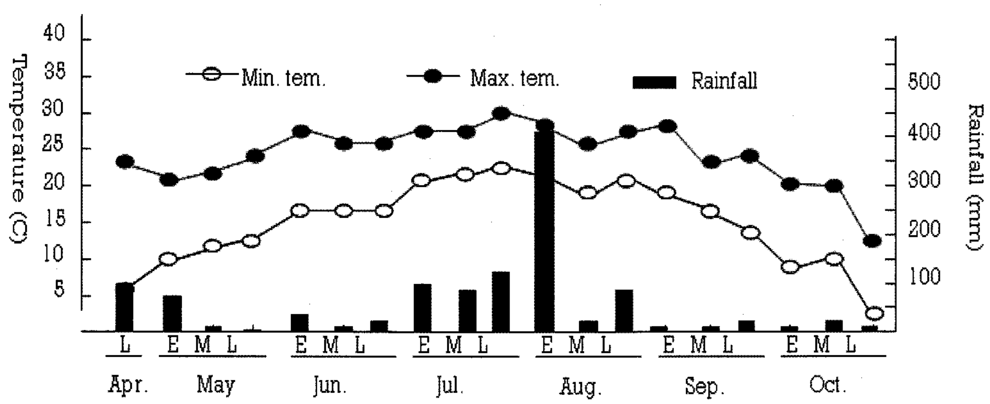

Fig. 1. Rainfall and temperature conditions during sesame cultivation season in year 2002.

Table 1. HPLC condition for lignan compounds analysis of sesame seeds.

Requests	Conditions
Column	ODS-5(250 mm × 4.6 ϕ)
Mobile phase	MeOH : Water = 6 : 4(v/v)
Detector	UV 290 nm
Flow rate	0.8 ml/min.

Table 3. Analysis of variance for sesamin and sesamolin contents according to sowing dates, varieties and day after flowering of sesame.

Sources	Mean Square	
	Sesamin	Sesamolin
Sowing date	0.008^{ns}	0.007^{ns}
Genotype	0.272**	0.165**
Day after flowering	0.056**	0.026*

*, ** : Significant at the 5%, 1% level respectively

RESULTS AND DISCUSSION

Analysis of variance to agronomic traits and lignan contents

General agronomic traits and lignan contents of Yangbaekkae and Yanghuckkae showed Table 2. Average flowering and maturity dates were July 3 and October 14 respectively. Number of capsule per plant was averaged to 63. Yangbaekkae showed higher oil content than Yanghuckkae. Especially, Yangbaekkae contained two times of lignan compounds much more than Yanghuckkae.

In the analysis of variance of lignan contents, sesamin and sesamolin contents showed significantly different by varieties and days of flowering, but no statistical difference by sowing dates (Table 3). As mentioned previously, Yangbaekkae contained higher lignan compounds than Yanghuckkae which showed statistical difference of lignan contents by sesame varieties. Table 3 also showed that sesamin and sesamolin contents were different by days of flowering. Many reports said that lignan as well as oil contents in sesame sharply increased after 10 days of flowering up to 45 days of flowering and curved to decrease (Kang *et al.,* 2000; Ryu *et al.,* 1993; Khidir *et al.,* 1972).

Changes of sesmin and sesamolin content as affected by sowing dates

Sesamin contents were changed according to sowing dates and days after flowering (Fig. 2). Sesamin contents gradually increased at 20 days after flowering and highest at 40 days after flowering. In comparison of sesamin contents by sowing dates, sowing date of May 30 which is 20 days late than optimum sesame sowing date showed higher sesamin contents at the same days after flowering stages than other sowing dates. Therefore, more accurate sesamin contents of sesame varieties would be determined at 40 days after flowering under sowing date of May 30.

Table 2. Agronomic traits and yield components of two sesame varieties.

Variety	Flowering date	Maturity date	Stem length (cm)	No. of capsule per plant	Oil content (%)	Lignan content (mg/g of seed)		Grain yield (kg/10a)
						Sesamin	Sesamolin	
Yangbaekkae	July 2	Oct. 12	126	65	53	4.53	3.45	76
Yanghuckkae	July 4	Oct. 15	117	60	47	1.78	1.43	65

†Sowing date : May 10

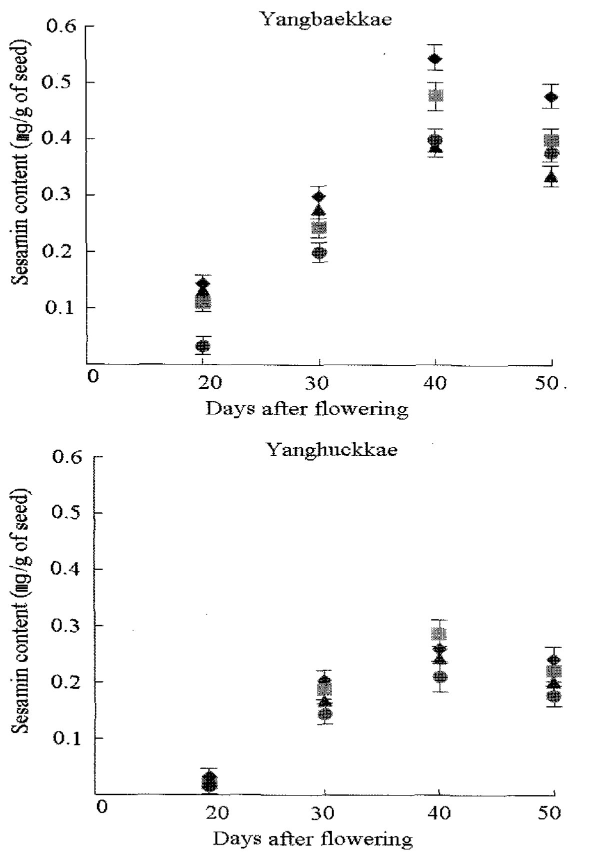

Fig. 2. Changes of sesamin contents of sesame seeds according to days of flowering in different sowing dates. ● : April 20, ■ : May 10, ◆ : May 30, ▲ : June 10.

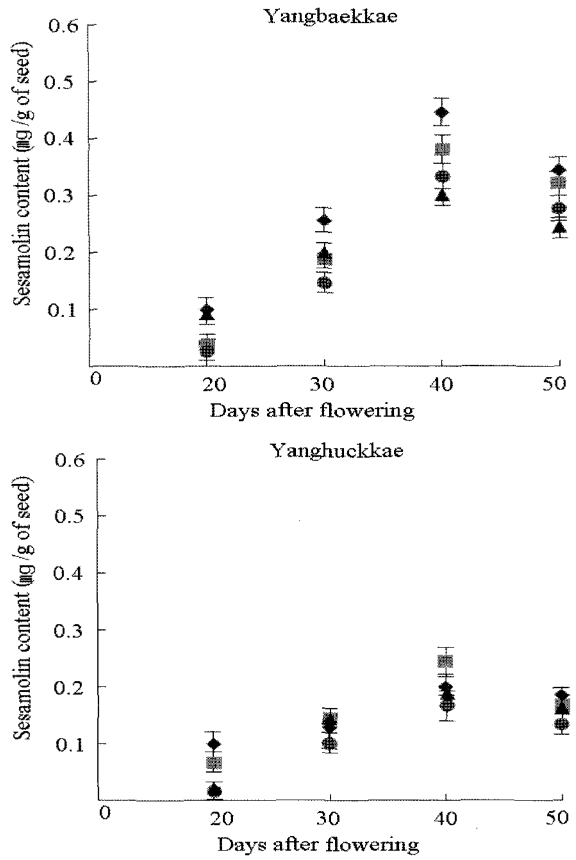

Fig. 3. Changes of sesamolin contents of sesame seeds according to days of flowering in different sowing dates. ●: April 20, ■ : May 10, ◆ : May 30, ▲ : June 10.

Sesamolin contents showed a little different response at the days after flowering under several sowing dates and sesame varieties (Fig. 3). Sesamolin contents in Yangbaekkae increased at 20 days after flowering and highest at 40 days after flowering at any sowing dates which is the same change patterns of sesamin content. But Yanghuckkae showed different change of sesamolin contents at the sowing dates in which sowing date of May 30 showed highest sesamolin contents at 20 and 50 days after flowering, but sowing date of May 10 showed highest sesamolin contents at 30 and 40 days after flowering. Therefore, optimum sesamolin contents of sesame variety Yanghuckkae would be determined at 40 days after flowering under sowing date of May 10.

In this study, we got some information that different evaluation criteria to determine accurate sesamin and sesamolin contents of sesame seeds were needed according to sesame varieties and sowing dates.

Table 4 showed variation of sesamin and sesamolin contents of sesame seeds according to sesame varieties and days of flowering. Yangbaekkae contained much more lignan contents rather than Yanghuckkae. Both of sesamin and sesamolin content were significantly different by days after

Table 4. Variation of sesamin and sesamolin contents of sesame varieties according to days of flowering.

Variety	Traits	DAF†	Mean	Minimum	Maximum
Yangbaekkae	Sesamin	20	0.11^{d*}	0.09	0.14
		30	0.24^{c}	0.20	0.29
		40	0.48^{a}	0.40	0.55
		50	0.39^{b}	0.33	0.43
	Sesamolin	20	0.07^{c}	0.03	0.12
		30	0.19^{b}	0.11	0.28
		40	0.37^{a}	0.29	0.53
		50	0.32^{ab}	0.28	0.39
Yanghuckkae	Sesamin	20	0.03^{c}	0.01	0.05
		30	0.19^{b}	0.12	0.27
		40	0.28^{a}	0.20	0.38
		50	0.22^{ab}	0.17	0.33
	Sesamolin	20	0.07^{c}	0.03	0.12
		30	0.14^{bc}	0.10	0.23
		40	0.24^{a}	0.17	0.32
		50	0.17^{b}	0.10	0.27

† DAF : Days of flowering, sowing date : May 10, flowering date : July 3

* Means followed by a same letter are not significantly different at the 5% level by DMRT.

flowering. Generally, sesmin and sesamolin contents of sesame seeds increased up to 40 days after flowering and sharply decreased thereafter.

Yasumoto *et al.* (2005) also reported that maturity of individual capsule was not uniform in a sesame plant. The size and the sesamin and sesamolin contents of seeds also were different by the capsules. Usually seed weight at upper position of capsule is lighter and flowered later. To determine more accurate lignan contents of sesame seeds in plant, it is necessary to evaluate lignan contents according to capsule position of main and branch stems. In this study, sesame seeds of capsules around 40 days after flowering showed a large varietal and sowing dates' difference in sesamin and sesamolin contents.

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