Screening and drying conditions for early harvested sunflower

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ABSTRACT

Screening tests were held to examine the method to remove admixture from the sunflower grain before drying process. Moisture contents of samples were 34.4% and 20.0%. Screening sizes examined were 1.0-5.0 mm. According to the results obtained, it is difficult to fix a certain screen gap size to remove most admixtures because size of grain varies from year to year and grain and admixture have almost the same size. However, using the 2.0 mm gap screen, a certain ratio (26-75%) of admixture, which is smaller than the grain, can be removed, and this is good for drying process in order to reduce machine trouble and extra energy to dry the admixture. The drying conditions and their effects on quality of sunflower, especially on oil quality, were also analysed for POV (peroxide value), AV (acid value) and color of oil. The sunflower plant material was cv Harurinzo (Pioneer:63M80) and the initial moisture contents were of 15.8% w.b. and 31.5%. Each sample was dried in an oven with 45°C, 55°C , 65°C for 24 hours and a circulating dryer (capacity: 1 t) for 11 hours. Samples were expressed with a small expeller. The oil samples were analysed for POV and AV. POV of sunflower oil ranged from 1.9 meq/kg for 45°C drying with 15.8% initial moisture content to 6.8 meq/kg for 65°C with 31.5% initial moisture content. According to the results obtained, it is concluded that in order to avoid the degradation of oil quality, the initial moisture content should be low enough, and, if the harvested sunflower has a high moisture content, drying it at a lower temperature is better to maintain the quality of the oil.

Key words: acid value – drying – early harvesting – peroxide value – screening

INTRODUCTION

Recently, sunflower and rapeseed cultivated areas have increased rapidly in Japan because of the growing expectations of bio-fuels made from oil from those crops. But there are some problems in producing sunflower in Japan. One major reason is that farmers do not have enough experience of growing, harvesting and drying of sunflower.

The high admixture rate is a problem. In drying process much energy is lost in drying grain with so many admixtures. Moreover, with respect to the oil expressing process, a high admixture rate reduces the yield of the oil expressed and sometimes causes machine troubles. The admixture rate in a harvested crop occasionally reaches 20%. The high admixture rate is the result of harvesting sunflower under high moisture conditions, especially with high moisture in the stem and receptacle, with a harvester designed for rice or wheat.

In Japan, because of the high humidity in the climate, the drying process is inevitable. But farmers do not know the appropriate drying condition for sunflower, because of their lack of enough experience, and sometimes they degrade the quality of the sunflower grain through drying process. Therefore, it would be necessary to clarify the effect of the drying conditions on the quality of sunflower grain and its oil and to fix the drying conditions for this crop.

The size of the screen gap for removing the admixture from sunflower before its drying process was examined. Also, the drying conditions for keeping the oil quality high were examined with POV (peroxide value) and AV (acid value).

MATERIALS AND METHODS

Screening test

Experiments were held in 2006 and 2007. In 2006, the sample was harvested with 34.4% moisture content in Hikawa city, Shimane pref., Japan. The sample was sorted with the size grader before drying. The screen gaps examined were 2.0, 2.4, 2.8, 3.2, 3.6, and 4.0 mm. In 2007, the sample was harvested with 21.0% moisture content. The sample was sorted with the size grader before drying and the screen gaps examined were 2.0, 3.0, 4.0, and 5.0 mm. In both cases, the admixture was separated after drying with a winnower for experimental use and its weight was measured.

Material and initial moisture contents
The sunflower cultivar Harurinzo (Pioneer:63M80) was grown with usual cultivation practices from June to October of 2006 in the south of Ibaraki Prefecture, Japan. Samples were harvested twice. The moisture contents of each sampling were "*I*: 15.8%" and "*II*: 31.5%". Moisture contents were measured with the 10 g (grain) -105°C-24 hours method.

Drying settings
To fix the best drying temperature for each moisture contents samples were dried with the air of "*A*: unheated", "*B*: 45°C", "*C*: 55°C" and "*D*: 65°C." A circulating dryer (*E*) was used because this dryer is very popular with Japanese rice farmers and it is useful if it can be utilized for drying of sunflower.

Drying settings were shown in Table 1. For *A* the ventilation dryer, Issingo Kaneko Agricultural machinery co., Ltd, has 6.6 m^2 mesh deck and air flow upward by blower (0.75kW) without burner burning. The drying oven was Espec Convection Oven LC-123. The circulating dryer was Iseki GA100 (Capacity: 400-1200 kg of wheat).

Each sample from *A* to *D* was about 2 kg and packed in 30cm x 40cm plastic mesh bags. Sample *E* was dealt as bulk. After drying, each sample was preserved in 10°C refrigerator.

Table 1. Drying Settings

	Dryer	Air Temperature (°C)	Drying time (hr.)
A	Ventilation dryer	Unheated	24
B	Drying oven	45	24
C	Drying oven	55	24
D	Drying oven	65	24
E	Drying oven	Unheated-55 (changing)	11

Expression of oil sample
A small expeller (San-Seiki S100-200, Capacity: 3.5 kg/h) was used. Moisture contents of samples were 5-6% when expelled. Yield of oil was 20-30% of the input grain weight.

Evaluation of oil quality
Expelled oil samples were examined by POV (peroxide value), AV (acid value) and the color of oil. POV and AV are used as indices for oil as food constituent. The measurement of POV and AV were outsourced to Japan Institute of Oil, Fats and Other Foods Inspection Foundation and analysed using Standard Methods for the Analysis of Fats, Oils and Related Materials (Japan Oil Chemists' Society).

RESULTS AND DISCUSSION

Screening test
Results of the screening test are shown in Fig. 1 and Fig. 2. In 2006 (Fig. 1), the admixture rate was 14.4% of whole weight. The admixture classified into 0-2.0 mm was 10.8%, others were lower than 1.0% of whole sample. 75% of the total admixture was classified into 0-2.0 mm. For the grain, 55.7% of whole sample, 65.1% of grain, was classified into more than 4.0 mm class.

In 2007, (Fig. 2) the admixture rate was 20.4% of whole weight. The admixture classified into 0-2.0 mm was 5.4%, 2.0-3.0 mm 4.2%, 3.0-4.0 mm 7.1%, 4.0-5.0 mm 3.0% and 5.0 mm- 0.7%. 26.5% of the admixture was classified into 0-2.0 mm. For the grain 37.0% of whole sample, 45.5% of grain was classified into more than 3.0-4.0mm class. And 36.2% of whole sample, 45.4% of grain was classified into more than 4.0-5.0 mm class.

From the results it is difficult to fix a certain size of screen gap to remove most of the admixture from mixture of grain and admixture because the grain size is different every year due to environmental conditions. However, screening with 2.0 mm screen removes 26-75% of the admixture. This seems to be of use as a rough screening before drying process because it will reduce the energy used for drying and the risk of machine trouble from the dryer even if the screening process after drying is inevitable.

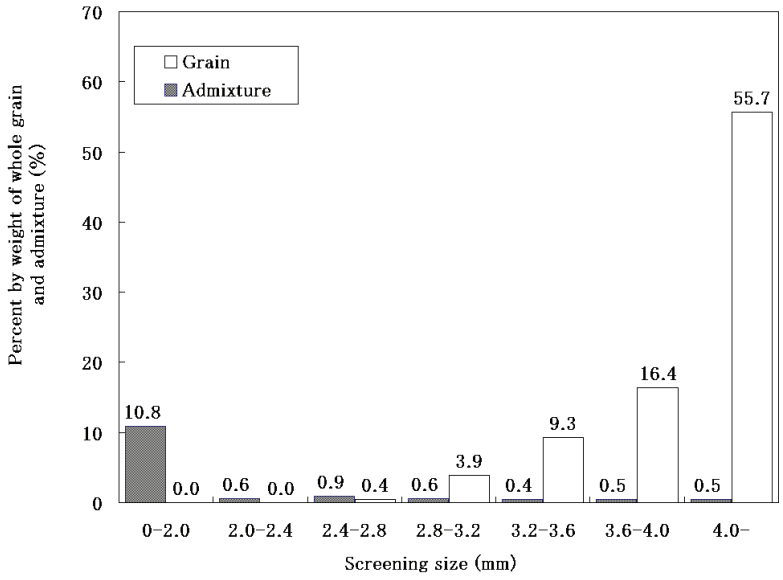

Fig. 1. Results of admixture screening test in 2006

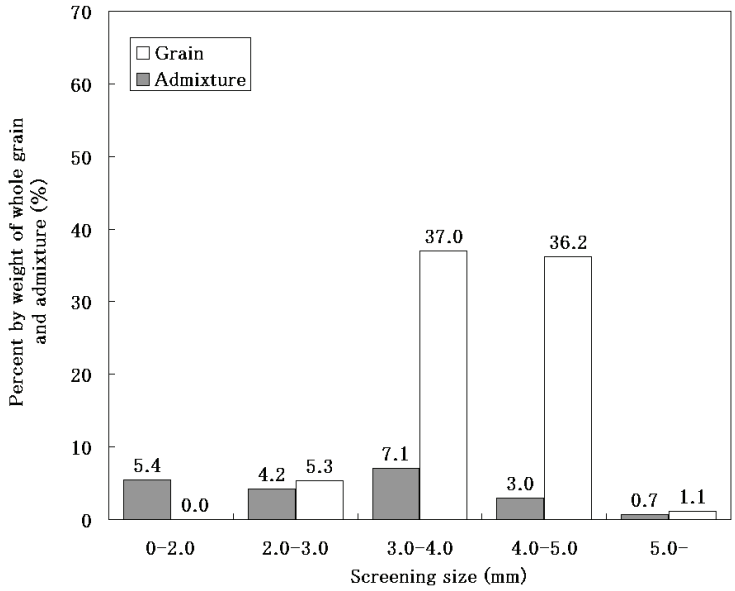

Fig. 2. Results of admixture screening test in 2007

Drying conditions

Fig. 3 shows POV of sunflower dried under each setting. When the initial moisture content was 15.8% (*I*), *D* setting had the highest POV followed by *C, B* and *A* which was the lowest. When the initial moisture content was 31.5% (*II*), *E* setting had the highest POV followed by *D, C, B* and *A*, which was the lowest.

The higher drying temperature resulted in a higher POV. That tendency was stronger for higher initial moisture content, 31.5% (*II*) than for 15.8% (*I*). The results also showed the effect of the initial moisture content on POV. POV of *II* (31.5%) was higher than that of *I* (15.8%) in all drying conditions from *A* to *D*.

It is concluded that to avoid the degradation of oil, firstly it is important to harvest enough dried grain below 16%. Secondly, if the harvested grain has a high moisture content of around 30% it should be dried with unheated or low temperature air.

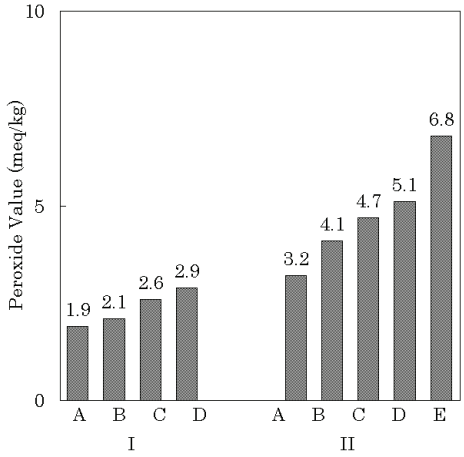

Fig. 3. POV of sunflower under each drying condition

The AV of sunflower oil of each sample varied from 0.3 to 0.7 and did not show any effects from the drying condition. Average of the AV of *I* was 0.3 and *II* 0.48. AV seems to have a proportional relationship with the initial moisture content.

The oil with an AV of over 1.0 was classified as being unsuitable for food, based on Japanese Standard. The AV of sunflower oil fulfilled the standard. The drying conditions did not have much effect on the deterioration of the AV. This implied that the higher initial moisture content of the grain caused a higher AV.

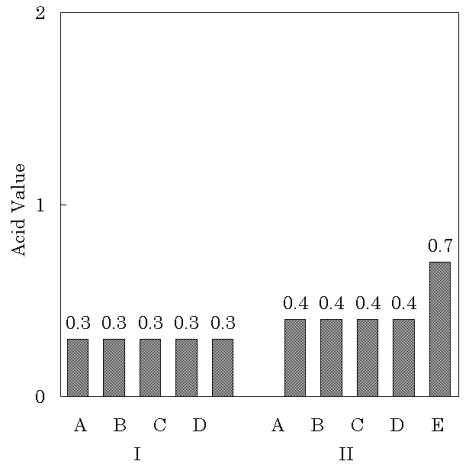

Fig. 4. AV of sunflower under each drying condition

CONCLUSIONS

The size of the screen gap in removing the admixture from sunflower before its drying process was examined. Also, the drying conditions for keeping the oil quality high were examined with POV (peroxide value) and AV (acid value). The conclusions of this study are follows:

1) From the results it was seen to be difficult to fix a certain size of screen gap to remove most of the admixture from mixture of grain and admixture because the grain size is different every year due to environmental conditions. However, screening with 2.0 mm screen removed 26-75% of the admixture. This would seem useful as a rough screening before drying process because it reduces drying energy and the risk of machine trouble from the dryer even if the screening process after drying is inevitable.

2) To avoid the degradation of oil, firstly it is important to harvest enough dried grain below 16%, and, secondly, if the harvested grain has a high moisture content of around 30% it should be dried with unheated or low temperature air.

3) The drying conditions did not have much effect on the deterioration of the AV. This implied that the higher initial moisture content of the grain gave a higher AV.