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Effect of anti-mould agents on the quality of preserved decanted solid from palm oil mill effluent

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Key words: palm oil mill effluent, anti-mould agents, mouldiness, fermentation

Abstrak

Lima percubaan telah dilaksanakan untuk membandingkan kesan agen-agen pencegah kulat terhadap efluen kilang kelapa sawit (EKKS) separuh kering (20–30% bahan kering). Dalam percubaan ini, agen pencegah kulat *Mycostatin-20* (nystatin) didapati berkesan untuk menahan pertumbuhan kulat tetapi tidak berkesan untuk mencegah fermentasi dalam EKKS. Natrium benzoat dan asid benzoik masing-masing sebanyak 2 g/kg boleh menjalankan kedua-dua fungsi ini. EKKS disyorkan supaya diawet sebelum dicampurkan dengan bahan makanan yang lain. Campuran makanan mestilah diberi kepada ternakan dengan serta merta.

Abstract

Five trials were conducted to compare the effectiveness of commercial anti-mould agents on the prevention of mouldiness in partially dehydrated palm oil mill effluent (POME) which contained 20–30% dry matter. The anti-mould agent *Mycostatin-20* was effective in checking mould growth but ineffective in preventing fermentation of POME. Sodium benzoate and benzoic acid at 2 g/kg level respectively were effective for these two functions. It is suggested that preservation should only be carried out with POME sample alone before being mixed with other feedstuffs. The feed mixture should be fed to animals immediately.

Introduction

Partially dehydrated palm oil mill effluent (POME) from the decanter which contains 70–80% moisture is known to be susceptible to rapid mould growth. The species of the mould are mainly *Neurospora* species mixed with small portions of *Mucor* and *Aspergillus* species (Lee, B. S., MARDI, Serdang, *pers. comm.* 1985). The mould usually starts growing within 24 h after the POME is exposed to the environment. This phenomenon will adversely affect the use of POME as animal feeds. On the other hand, POME which is dehydrated by hot air in a rotary drum is known to be low in digestibilities of dry matter and protein (Yeong 1983), possibly due to the drastic dehydration process. Therefore, the decanted fresh solid is expected to have better nutritive values.

This article reports the results of five trials using several anti-mould agents for preserving the fresh POME solid from mould infestation. The objective of this study was to select a suitable anti-mould agent which is effective in preventing mouldiness in the POME.

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Materials and methods

Five trials were conducted successively with decanted POME solid obtained from Sungei Pancing Palm Oil Mill at Felda Estate, Kuantan and Jaya Palm Oil Mill, Kelang. The POME contains 20–30% dry matter (DM). Its chemical composition in DM basis is as follows: crude protein 16.3%, ether extract 14.2%, crude fibre 26.9%, ash 14.9% and gross energy 4 360 kcal/kg.

Trial 1

Three types of anti-mould agents (formaldehyde, sodium benzoate and sodium propionate) were compared for their anti-mould effect in POME sample. The inclusion levels of these anti-mould agents were at 0.05, 0.1, 0.5, 1.0 and 10.0 g/kg basis. Each treatment was carried out using 1 kg of POME. When sampling was conducted outstation, the samples were mixed with the anti-mould agents at the site of the palm oil mill. Upon reaching the laboratory at MARDI, Serdang, all the samples, except those in air-tight polyethylene bags, were transferred to petri dishes in duplicate using 100 g of each of the samples. They were kept in an incubator at 32 °C. A 4-point score was used to measure the severity of mouldiness in the samples for 6 days.

Trial 2

A combination of a commercial anti-mould agent *Moldcurb* (a propionic acid based additive) and an antioxidant *Endox* was used in a 50:50 POME-palm kernel cake mixture. Both *Moldcurb* and *Endox* are usually used in animal feed to prevent mouldiness and rancidity. Since POME is very moist, palm kernel cake (PKC) was mixed in as an absorbent for the moisture. This mixture of POME:PKC in 50:50 ratio in dry matter basis is usually used as cattle fattening diet. It is hoped that the mouldy condition can be reduced by the decrease of total moisture level in this mixture. The levels of *Moldcurb* inclusion into the mixture were at 0.25, 0.5 and 1.0 g/kg with or without the inclusion of 0.25 g *Endox*/kg of mixture. A sample of POME-PKC mixture without the above agents was used as a control. A 100 g of each of the samples was transferred to petri dishes and incubated under constant temperature of 32 °C. The incidence of mouldiness on the samples was recorded at the third and fourth day.

Trial 3

Three more commercial anti-mould agents (*Luctamold, Mycostatin-20* and sodium benzoate) were compared. In view of the results of Trial 2, in which most of the samples of mixture were mouldy, in this trial, two types of sample materials, a mixture of 50:50 POME-PKC and a pure wet POME sample were compared. The inclusion levels of *Luctamold* in the 50:50 mixture were 1, 3 and 6 g/kg, and *Mycostatin-20* at 1, 2 and 4 g/kg. In POME samples, the inclusions were 6, 4 and 3 g/kg for *Luctamold, Mycostatin-20* and sodium benzoate respectively. The incidence of mouldiness was recorded for 3, 6 and 9 days.

Trial 4

Since the anti-mould agents worked more effectively in pure POME sample than in the POME-PKC mixture, in this trial, attention was only given to pure POME sample. Anti-mould agents including *Mycostatin-20, Moldcurb, Luctamold* and sodium benzoate were compared for their effectiveness in controlling mould infestation in POME sample. Two samples from an open or air-tight condition without anti-mould agents in polyethylene bags were used as references to the treatments. The effect of anti-mould agents on the prevention of fermentation in the POME sample was also studied. The degree of fermentation was based on the freshness of the POME samples at the ninth day. Smell and colour were the criteria of the measurement.

Table 1. Effect of anti-mould agents on the incidence of mouldiness in POME in Trial 1

Anti-mould agent	Level (g/kg)	Score of mouldiness*	
		3rd day	6th day
Control	0	3	4
Formaldehyde	0.1	3	4
	0.5	2	4
	1.0	2	4
	10.0	0	0
Na benzoate	0.05	2	4
	0.1	2	4
	1.0	0	1
	10.0	0	0
Na propionate	0.05	2	2
	0.1	2	2
	1.0	1	1
	10.0	0	0

*1–4 = seriousness of mould growth
0 = no visible mould growth

Table 2. Effect of *Moldcurb* and *Endox* inclusion on the incidence of mouldiness in POME-PKC mixture (50:50 on DM basis) in Trial 2

*Moldcurb** (g/kg)	*Endox*** (g/kg)	Incidence of mouldiness	
		3rd day	4th day
0	0	+	+
0.25	0	+	+
0.5	0	+	+
1.0	0	–	+
0.25	0.25	+	+
0.5	0.25	+	+
1.0	0.25	+	+

+ = presence of mould growth
– = absence of mould growth
*anti-mould agent of Kemin Industries Inc., U.S.A.
**antioxidant of Kemin Industries Inc., U.S.A.

Trial 5

All the selected anti-mould agents in the previous trials were included in this concluding trial. However, benzoic acid was included to compare with sodium benzoate. The degree of mouldiness was noted at the 5th, 10th and 15th day and the fermentation at the 15th day.

Results and discussion

Trial 1

The three anti-mould agents (formaldehyde, sodium benzoate and sodium propionate) were only effective when their inclusion levels in the decanted POME sample were at 10.0 g/kg (*Table 1*). However, the sodium benzoate at 1 g/kg was effective in controlling the mouldiness for the first 3 days. Sodium propionate was less effective than sodium benzoate but more effective than formaldehyde.

Trial 2

The commercial anti-mould agent, *Moldcurb*, in 0.25, 0.5 and 1.0 g/kg levels of inclusion in POME:PKC mixture (50:50 on DM basis) with or without the

Table 3. Effect of anti-mould agents on the incidence of mouldiness in POME-PKC mixture (50:50 on DM basis) and POME sample in Trial 3

Sample	Anti-mould agent	Level (g/kg)	Incidence of mouldiness		
			3rd day	6th day	9th day
Mixture	*Luctamold**	1	–	+	+
Mixture	*Luctamold*	3	–	+	+
Mixture	*Luctamold*	6	–	+	+
Mixture	*Mycostatin-20***	1	–	+	+
Mixture	*Mycostatin-20*	2	–	+	+
Mixture	*Mycostatin-20*	4	–	+	+
POME	*Luctamold*	6	–	+	+
POME	*Mycostatin-20*	4	–	–	–
POME	Na benzoate	3	–	–	–

* a fungicide composed of organic acids, polyols and others from Lucta, S.A., Spain
**nystatin, an antibiotic for mould control from Squibb, U.S.A.
+ = presence of mould growth
– = absence of mould growth

Table 4. Effect of different anti-mould agents in POME on the incidence of mouldiness in relation to inclusion level in Trial 4

Anti-mould agent	Level (g/kg)	Score of mouldiness*	
		3rd day	6th day
Control (air tight)		3	4
Control (open air)		3	4
Mycostatin-20	1	1	2
Mycostatin-20	2	1	2
Mycostatin-20	4	0	0
Mycostatin-20	6	0	0
Moldcurb	2	1	3
Moldcurb	4	1	3
Luctamold	3	2	4
Luctamold	6	1	3
Na benzoate	1	0	1
Na benzoate	2	0	0
Na benzoate	3	0	0

*1–4 = seriousness of mould growth
0 = no visible mould growth

addition of 0.25% antioxidant *Endox* did not prove to be effective in suppressing mouldiness at the fourth day (*Table 2*). The *Moldcurb* at 1.0 g/kg level seemed to be effective up to the third day but not effective in the 1 g/kg *Moldcurb* + 0.25 g/kg *Endox* group. Since *Endox* does not have anything to do with mouldiness, it showed that at 1 g/kg level, *Moldcurb* was not stable in suppressing mould growth.

Trial 3

No incidence of mouldiness was found in both types of samples with different anti-mould agents in the first 3 days (*Table 3*). However, in the subsequent sixth and ninth day, incidence of mouldiness occurred in most of the samples except the two POME samples with *Mycostatin-20* at 4 g/kg level and sodium benzoate at 3 g/kg level. The *Luctamold* at the level of 6 g/kg

did not prevent mould growth in the later period. The results of this trial showed that the preservation against mouldiness should only be carried out in pure POME sample as the POME-PKC mixture could have been infested with mould from PKC.

Trial 4

This trial was also to confirm the effect of some of the agents such as sodium benzoate and *Mycostatin-20* in POME samples. In addition, the results showed the severity of the mouldiness in relation to the levels of inclusion of the various anti-mould agents *(Table 4)*. The control POME samples in air-tight and open polyethylene bags exhibited severe mouldiness in 3 days. Although some of the anti-mould agents like *Moldcurb* and *Luctamold* in higher dosages did partially suppress mould growth in the first 3 days, the mouldiness eventually became serious on the sixth day. However, *Mycostatin-20* at 4 and 6 g/kg levels and sodium benzoate at 2 and 3 g/kg levels were able to prevent mould growth completely. Sodium benzoate at 1 g/kg level was effective for the first 3 days and partially effective until the sixth day.

From this trial, it is confirmed that the propionate based anti-mould agents are not effective in controlling mouldiness in POME. Thus, only the antibiotic nystatin (*Mycostatin-20*) and sodium benzoate are effective for this purpose.

It is possible to differentiate the degree of freshness in POME samples preserved by nystatin and sodium benzoate. The samples with nystatin would turn black and sour by the internal fermentation although there was no mouldiness on the surface of the samples. However, sodium benzoate was able to prevent both mould growth and fermentation and hence maintain the freshness of the POME samples. This was verified by the difference in acceptance by poultry when the two types of preserved POME were fed to them.

Trial 5

This trial compared the effect of benzoic acid with that of sodium benzoate in preventing mould growth and also confirmed the effect of these two anti-mould agents in suppressing fermentation in the POME samples. All the commercial anti-mould agents selected were also compared in this study (*Table 5*). In the first 5 days of the trial, all the anti-mould agents were effective in preventing mould growth at certain inclusion levels in the POME samples. The following are the anti-mould agents and their respective lowest effective levels: benzoic acid at 1 g/kg; sodium benzoate at 1 g/kg; sodium propionate at 2 g/kg; *Moldcurb* at 4 g/kg; *Luctamold* at 6 g/kg; and *Mycostatin-20* at 2 g/kg. At the 10th day, at low levels of inclusion, most of the POME samples with anti-mould agents were infested with mould with the exception of *Mycostatin-20* which effectively prevented infestation. However, benzoic acid at 2 g/kg level, sodium benzoate at 2 and 3 g/kg levels and sodium propionate at 4 g/kg level were able to prevent mould infestation. This same situation persisted at even the 15th day except for the sample with *Mycostatin-20* at 2 g/kg level where a small speck of mould was found. All the anti-mould agents except benzoic acid and its sodium salt were not effective in preventing fermentation in the POME samples. It is therefore suggested that benzoic acid and sodium benzoate at 2 g/kg level respectively are effective in preventing mould growth and fermentation for decanted POME.

Conclusion

Most of the commercial organic acid-based anti-mould agents were not completely effective in preventing mouldiness in partially dehydrated POME from the decanter. The antibiotic-based *Mycostatin-20* (nystatin) was more effective among them. However, it was not effective in controlling fermentation

Table 5. Effect of anti-mould agents on the incidence of mouldiness and fermentation in POME samples in Trial 5

Anti-mould agent	Level (g/kg)	Score of mouldiness*			Fermentation (15th day)
		5th day	10th day	15th day	
Control (air tight)		3	4	4	1
Benzoic acid	1	0	2	3	1
Benzoic acid	2	0	0	0	0
Na benzoate	1	0	2	3	1
Na benzoate	2	0	0	0	0
Na benzoate	3	0	0	0	0
Na propionate	2	0	1	2	1
Na propionate	4	0	0	0	1
Moldcurb	2	1	1	3	1
Moldcurb	4	0	1	3	1
Luctamold	3	2	3	4	1
Luctamold	6	0	2	3	1
Mycostatin-20	2	0	0	1	1
Mycostatin-20	4	0	0	0	1

*1–4 = seriousness of mould growth
0 = no visible mould growth

in the POME samples. On the other hand, benzoic acid and its sodium salt are able to serve both of these purposes. Their recommended levels of inclusion are respectively 2 g/kg in decanted POME. It is suggested that the preservation should not be carried out in feed mixture since secondary components will introduce higher levels of microbes which will intensify the severity of mould growth. Therefore, preservation should be conducted on POME alone before it is mixed for animal feeding. Once the feed is mixed, it should be fed to the animal within the same day. It is recommended that the preserved decanted POME should be used within 3 days.

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Reference

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