

**ผลของรำข้าวสีกัดน้ำมันที่ผ่านขบวนการไฮโดรไลซ์ด้วยเอนไซม์
ไฟเตสรวมกับการดัดการใช้ประโยชน์ได้ของฟอสฟอรัสและคุณค่า
ทางโภชนาการในอาหารสุกรหย่านม**

**Effects of Hydrolyzed Rice Bran Extracted with Enzyme Phytase
in Combination with Acid on Available Phosphorus
and Nutritive Value in Weaning Pigs**

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Abstract

A trial was conducted to examine the effects of four different methods of hydrolyzed rice bran extracted supplementation 10% for replacement rice bran extracted in basal weaning pigs compare negative and positive control on growth performance, uniformity of body weight at termination (UBWT) and survival in rate in the 21-56d, 288 weaning pigs with equal sex. All diets contain 20.3% crude protein and 3.37 Mcal ME/kg diet. Feeding with four different methods of hydrolyzed rice bran extracted were not significant ($P>0.05$) on ADFI and survival rate when compared with both negative and possitive control groups, but showed significant ($P<0.05$) effects on BWG, ADG, UBWT. Weaning pigs fed with hydrolyzed rice bran extracted with hydrochloric acid 0.1% in combination with 1000 FTU phytase with 45% moisture for 24 h showed better improved ($P<0.05$) FCR when compared with the other groups. The results of this study showed that all four methods of hydrolyzed rice bran extracted showed multi-properties effect of biotechnology process by enzyme on liberating inorganic phosphorus with low antinutritional factors and improved feed quality in the weaning diets when comparing among with the negative and the positive control groups.

Keywords : Phytase, rice bran extracted, weaning pigs

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บทคัดย่อ

ทำการศึกษาทดสอบรำข้าวสาคัดน้ำมันไฮโดรไลซ์ 4 ชนิด โดยทดแทนรำข้าวสาคัดน้ำมัน 10% ในอาหารสุกรหย่านม เปรียบเทียบกับสูตรควบคุมลบและบวก ต่อสมรรถนะการเจริญเติบโต ความสม่ำเสมอของน้ำหนักตัวเมื่อสิ้นสุดการทดลอง และอัตราการเลี้ยงรอดในลูกสุกรช่วงอายุ 21-56 วัน จำนวน 288 ตัว มีเพศเท่ากัน ลูกสุกรหย่านมที่เลี้ยงด้วยอาหารรำข้าวสาคัดน้ำมันไฮโดรไลซ์ทั้ง 4 ชนิด จะให้อัตราการกินอาหารต่อวัน และอัตราการเลี้ยงรอดไม่มีผลแตกต่างกันทางสถิติ ($P>0.05$) เมื่อเปรียบเทียบกับลูกสุกรหย่านมที่เลี้ยงด้วยอาหารสูตรควบคุมลบและบวก แต่พบว่าน้ำหนักเพิ่ม อัตราเจริญเติบโตต่อวัน ความสม่ำเสมอของน้ำหนักตัวเมื่อสิ้นสุดการทดลอง แตกต่างกันทางสถิติ ($P>0.05$) ลูกสุกรหย่านมที่กินอาหารรำข้าวสาคัดน้ำมันไฮโดรไลซ์ด้วยกรดเกลือ 0.1% ร่วมกับเอนไซม์ไฟเตส 1000 FTU/กก. รำข้าวสาคัดน้ำมันความชื้น 45% เป็นเวลา 24 ชั่วโมง จะมีประสิทธิภาพการใช้อาหารดีกว่า ($P<0.05$) ทุกสูตรอาหารที่ทดสอบ ผลการทดลองครั้งนี้แสดงให้เห็นว่ากรรมวิธีทั้ง 4 วิธีในการไฮโดรไลซ์รำข้าวสาคัดน้ำมันแสดงผลเพิ่มคุณภาพหลายประการทางขบวนการไบโอเทคโนโลยีในการปลดปล่อยฟอสฟอรัสอินทรีย์ พร้อมทั้งลดสารขัดขวางการนำโคชนะไปใช้ประโยชน์ได้ของรำสาคัดน้ำมันและสามารถปรับปรุงสูตรอาหารของลูกสุกรหย่านมให้มีคุณภาพเพิ่มขึ้นเมื่อเปรียบเทียบกับลูกสุกรหย่านมที่เลี้ยงด้วยอาหารสูตรควบคุมลบและสูตรควบคุมบวก

คำสำคัญ : ไฟเตส รำข้าวสาคัดไฮโดรไลซ์ ลูกสุกรหย่านม

Introduction

Rice bran extracted has a longer storage life than full-fat rice bran and its sometimes referred to as “stabilized rice bran” Rice bran extracted contained higher protein but lower in energy with 75% metabolizable content compared with full-fat rice bran (Houston, 1972; Thacker and Kirkwood, 1990; Ravindran et. al., 2001). Rice bran extracted is high in phytate with values of up to 4% but more commonly about 3% (Warren and Farrell, 1989a). This may reduce the availability of some minerals in rice bran and in rice bran-based diet (Warren and Farrell, 1989a; Warren et. al., 1989b). Creswell (1987) has compiled mean rata of rice bran extracted from Thailand and India where adulteration with hulls occurs. The performance of swine fed diets based on rice bran varies depending largely on the level of adulteration with hulls (Thacker and Kirkwood, 1990). Campabadal et. al. (1976) concluded that

rice bran could be successfully used in weaner diets at up to 15% and at up to 30% in grower-finisher diets. However, in their experiment, weaners grew 54 g/d less (nonsignificant) on diets with 15% rice bran compared with those on diets with no bran. Warren et. al. (1981) substituted defatted rice bran at up to 30% into a commercial grower diet for weaner pigs (19 kg) without any adverse effect on performance to 45 kg liveweight. The interaction of phytate phosphorus with protein, vitamin and several minerals is considered to be one of the primary factors limiting the nutritive value of sow feed ingredients such as rice bran extracted. Hydrolyzed plant phytate prior to animal consumption would increase the availability of inositol and inorganic phosphorus to improve the feed quality has been reported (Chang et. al., 1977; Nelson et. al., 1968; Whitaker and Brunnert, 1977). Thus, the present study was conducted to determine the four different methods of hydrolyzed rice bran with

hydrochloric 0.1% or acetic acid 0.2% in combination with enzyme phytase (Natuphos® Gist-brocads and marked by BASF) with 45% moisture at room temperature for 12 h or 24 h compared with the negative control supplementation with enzyme phytase 500 FTU/kg diet and the positive group supplementation with dicalcium phosphate in weaning pigs diets.

Materials and Methods

A total of 288, 21-d-old weaning pigs (Landrace-Yorkshire x Duroc) from a well manage commercial farm in Khon Kaen Province were equally in sex on the basis of gender and body weight were used in each treatment with 2 replications of 12 pigs each (2 replication for males and 2 replications for females). Four different methods of rice bran extracted hydrolyze; (1) hydrolyzed with hydrochloric (HCl) 0.1% in combination with enzyme phytase 1000 FTU/kg rice bran extracted with 45% moisture at room temperature for 12 h, (2) as method (1) but using time for 24 h; (3) as method (1) but using acetic acid 0.2%, and (4) as method (3) but using time for 24h, were prepared and testing for in vitro on the liberating inorganic phosphorus by modified method of Anderson (1915). The four different methods of rice bran hydrolyzed was supplement 10% for replacement rice bran extracted in negative control basal weaning pigs diets compared with two control groups (negative control supplementation with 500 FTU phytase/kg diet and positive control supplementation with DCP (Table1). Both basal diets contain 20.3% crude protein 3.87 Mcal ME/kg diets. All weaning pigs were house in environmentally regulated nursery pen and fed ad libitum access of feed and water-throughout the study (21-56 d of age). Animal were weighted at initial and final weight.

Feed intake was recorded every day until termination. Pigs uniformity was accounted as percentage units that fall into two times of standard deviation based on average live weight at termination. A completely randomized design was applied using the GLM procedure of SAS (1988) and difference between treatments was tested using Duncan's multiple range tests.

Results and Discussion

The effects of four different methods of hydrolyzed rice bran extracted on performance of weaning pigs are presented in Table 2 Weaning pigs receiving hydrolyze rice bran extracted with HCl 0.1% in combination with 1000 FTU phytase/kg rice bran extracted with 45% moisture at room temperature for 24 h (HRBEGP24) showed the best and hydrolyzed rice bran extracted with acetic acid 0.2% in combination with 1000 FTU phytase/kg rice bean extracted with 45% moisture at room temperature for 12 h (HRBEAP12) showed the lowest performance but significant ($P<0.05$). When compared with the weaning pigs receiving the positive control supplementation with DCP group Weaning pigs fed with four different hydrolyzed methods of rice bran extracted showed no difference effects on average daily feed intake (ADFI), body weight gain (BWG), average daily gain (ADG) and survival rate but showed significant ($P<0.05$) effects on feed efficiency (feed convention ratio, FCR) and uniformity of body weight at termination (UBWT). When compared with weaning pigs fed the both control (negative or positive) groups showed no difference effects performance, survival rate and uniformity of body weight at termination (UBWT). These studies were confirmed the results of the previous study on hydrolyzed rice bran tested in weaning pigs. The results of this study clearly demonstrated that

hydrolyzed rice bran extracted with four different methods from the *in vitro* testing were verified with the results obtained by the *in vivo* testing in weaning pigs on liberating inorganic phosphorus and also improved the feed quality which have been reported by Chang et.al., 1977 and Whitaker

and Brunnert, 1977. Supplementation 500 FTU phytase/kg diet in negative control showed beneficial in better improved the feed quality but not statistical difference ($P>0.05$) when compared the pigs fed the positive control supplementation with DCP.

Table 1 Composition of the experimental diets

Ingredient	NC ^b	Hydrolyzed rice bran extracted				PC ^b
	+	Hydrochloric acid		Acetic acid		+
	Enzyme	12 h	24 h	12 h	24 h	DCP ^b
	T1	T2	T3	T4	T5	T6
Broken rice (7.5% CP)	35.49	35.66	35.66	35.66	35.66	35.53
Rice bran extracted (14.5% CP)	10.00	-	-	-	-	10.00
Rice bran extracted hydrolyzed (14.5% CP)**	-	10.00	10.00	10.00	10.00	-
Whey powder (11.5% CP)	12.00	12.00	12.00	12.00	12.00	12.00
Skim milk replacer (37.5% CP)	10.00	10.00	10.00	10.00	10.00	10.00
Fish meal (60% CP)	6.00	6.00	6.00	6.00	6.00	6.00
Full fat soybean meal (36% CP)	12.00	12.00	12.00	12.00	12.00	12.00
Soy bean meal (44%CP)	5.50	5.50	5.50	5.50	5.50	5.50
Crude rice oil	4.20	4.20	4.20	4.20	4.20	4.20
Dicalcium phosphate (P 18%)	0.93	0.93	0.93	0.93	0.93	1.40
Limestone	0.34	0.34	0.34	0.34	0.34	-
DL-Methionine	0.15	0.15	0.15	0.15	0.15	0.15
L-Lysine	0.20	0.20	0.20	0.20	0.20	0.20
Threonine	0.02	0.02	0.02	0.02	0.02	0.02
Dried porcine soluble (30% CP)	2.50	2.50	2.50	2.50	2.50	2.50
Premixes ^a	0.50	0.50	0.50	0.50	0.50	0.50
Phytase 500 FTU/kg	0.17	-	-	-	-	-
Calculated composition :						
Crude protein, %	20.33	20.34	20.34	20.34	20.34	20.33
ME, kcal / kg	3350	3355	3355	3355	3355	3351

^a In feed 1 kg: Vit.A 2,500 I.U., Vit.D3 250I.μ., Vit. E20 I.U., Vit.B12, 20 μg, panthothemic acid 12 mg, niacin 20 mg, Vit.B1, 4 mg, Vit.B2, 2 mg, choline chloride 1 g, Vit.B6, 2mg, biotin 0.3 mg, Vit.K3 0.5 mg, folic acid 0.3 mg, etoxiguine 12.5 mg, Co 250 mg, I 0.4 mg, Fe 100 mg, Mn 4 mg, Ce 0.3 mg, Zn 100 mg, Co 0.14 mg, tyrosine 110 ppm, sulphamethracine 110 ppm and cholistin 110 ppm.

^b NC= Negative control, PC= Possitive control, DCP=Dicalcium phosphate

** Hydrolyzed rice bran : (1) hydrolyzed with HCL 0.1% phytase 1000 FTU moisture 45% and 12 h, hydrolyzed time (2) same as (1) but using hydrolyze time 24 h , (3) as (1) but hydrolyzed with acetic acid 0.2% , and (4) as (3) but using hydrolyze time 24h.

Table 2 Effects of hydrolyzed rice bran extracted on body weight gain (BWG) average daily gain (ADG), daily feed in take (ADFI), feed efficiency (feed conversion ratio, FCR), uniformity of body weight at termination (UBWT) and survival rate of weaning pigs during 21-56 days of age^a

Parameters	Negative	Hydrolyzed rice bran extracted				Positive	Pooled SEM
	Control	HCl		Acetic acid		Control	
	+					+	
	Phytase	12 h	24 h	12 h	24 h	DCP	
	T1	T2	T3	T4	T5	T6	
No. of piglets	48	48	48	48	48	48	-
Av. Initial weight, kg/head	6.28	6.21	6.26	6.20	6.24	6.22	-
Av. Final weight, kg/head	20.76	20.67	20.87	20.61	20.59	20.61	-
BWG, kg/h	14.48ab	14.46ab	14.61a	14.41ab	14.35b	14.39ab	0.120
ADG, g/h/d	414ab	413ab	418a	407c	410 bc	411bc	3.277
ADFI, g/h/d	632	633	630	628	628	630	3.594
FCR	1.527a	1.532a	.509b	1.542a	1.532a	1.534a	0.010
UBWT, %	93.83ab	93.57b	95.75a	92.75b	94.24ab	93.56b	1.234
Survival rate, %	97.92	100.00	100.00	97.92	100.00	100.00	2.408

^a Values reported are means of four replications.

^{a-c} Means with different letters in the same row are significantly different (P<0.05).

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