

# STUDIES ON ATP RELATED COMPOUNDS, FREE AMINO ACIDS AND FREE SUGARS OF PORK FROM DIFFERENT BREEDS OF PIG IN TAIWAN

M.T. Chen\* and Y.W. Huang

Department of Bioindustry Technology, Da-Yeh University, 112 Shan Jeau Rd., Da Tsuen, Changhua, Taiwan 515.  
Email: michen@mail.dyu.edu.tw

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## Introduction

The aim of this study was to understand the water-soluble flavour compounds of pork, of five different breeds of pigs (Duroc, Yorkshire, Landrace, Black and hybrid (LYD)) which are popular breeds in Taiwan.

## Materials and Methods

Duroc (9), Yorkshire (8), Landrace (8), Black (11) and Hybrid (18) were fed for 6.5 to 7.5 months of age with the same composition of feeds, and slaughtered at a local slaughterhouse. The loin was taken and cooled at 2°C for analyses. The ATP and related compounds, free amino acids, free sugars, pH and moisture content were determined. The ATP and related compounds were analysed by a procedure modified from the methods of Boyle *et al.* (1991) and Ryder (1985). The samples were treated by the method described by Ryder (1985). Free amino acids were extracted using the method modified from Chu *et al.*, (1996) and Konosu *et al.*, (1974), and analysed by HPLC chromatography. Free sugars were extracted by the same method as free amino acids, and pre-column derivatised with PMP, then analyzed by HPLC. The pH value was determined with a pH-meter (HANNA, Italy) and moisture content was determined by the method of AOAC (1984). The data was analysed by SAS software (1994).

## Results and Discussion

The pH values and moisture content of pork from different breeds of pigs at the age of 6.5 to 7.5 months were found to range between pH 5.4 and 6.22, and 71.3 to 73%, respectively. Tables 1 and 2 indicate the concentration of ATP and its related compounds of pork from different breeds of pigs. The result found was that ATP depleted more rapidly from Black pig than others, and completely depleted after 24 hr postmortem, while Inosine and Hypoxanthin increased remarkably. It was found that inosine content in pork of hybrid was lower than the others 1 hr postmortem. After 24 hr postmortem change in inosine level from different breeds compared as follows: Duroc and Black>Landrace>Hybrid and Yorkshire in descending order. IMP content which is associated with meat flavour, was highest in pork from Duroc among the five breeds whether 1 hr or 24 hr postmortem. So Duroc is often used as the base for crossbreeding of the meat herd such as LYD. Table 3 shows the free amino acids and total free amino acids in pork from different breeds. It was found there were no significant differences in free amino acids and total amino acids contents among the different breeds, except the methionine was higher in hybrid pork. Table 4 shows free sugar contents in loin and ham from different breeds. Glucose of loin was the highest for Duroc, then Black>Landrace and Hybrid>Yorkshire in descending order, and ribose content was the highest in Hybrid pork and lowest in Black among the different breeds. However, free sugar content from ham was different from the result of loin. It was found that glucose contents in Duroc and Black were the highest and Yorkshire and Landrace were the lowest among the different breeds, while ribose content was found higher in Hybrid and Duroc than other breeds. The concentration of glucose in loin was higher when compared to the ham, but no significant difference in ribose was found between different parts.

**Table 1:** Comparison of ATP related compounds (mg/g) in pork loin \* \* from different breeds \* 1hr post-mortem.

Items/Breed	Black	Hybrid	Duroc	Yorkshire	Landrace
IMP	0.005±0.105 <sup>c</sup>	0.936±0.079 <sup>b</sup>	1.344±0.121 <sup>a</sup>	0.215±0.134 <sup>e</sup>	0.851±0.105 <sup>b</sup>
ATP	0.043±0.112 <sup>c</sup>	0.589±0.085 <sup>ab</sup>	0.478±0.130 <sup>b</sup>	0.676±0.143 <sup>ab</sup>	0.833±0.112 <sup>a</sup>
ADP	0.538±0.100 <sup>a</sup>	0.474±0.076 <sup>a</sup>	0.193±0.116 <sup>b</sup>	0.481±0.128 <sup>ab</sup>	0.194±0.100 <sup>b</sup>
AMP	1.092±0.105 <sup>a</sup>	0.175±0.080 <sup>c</sup>	0.339±0.122 <sup>bc</sup>	0.572±0.135 <sup>b</sup>	0.523±0.105 <sup>b</sup>
Hx	0.005±0.0015 <sup>bc</sup>	0.0013±0.001 <sup>d</sup>	0.012±0.002 <sup>a</sup>	0.008±0.002 <sup>ab</sup>	0.003±0.001 <sup>cd</sup>
Ino	0.088±0.012 <sup>a</sup>	0.031±0.009 <sup>b</sup>	0.105±0.014 <sup>a</sup>	0.097±0.016 <sup>a</sup>	0.070±0.012 <sup>a</sup>

\* Mean±S.E.

\* \* pigs were fed for 6.5-7.5 months.

<sup>a,b,c,d</sup> means within the same row without the same superscript letters are significantly different (P < 0.05).

**Table 2: Comparison of ATP related compounds (mg/g) \* in pork loin \*\* from different breeds 24hr post-mortem.**

Items/Breed	Black	Hybrid	Duroc	Yorkshire	Landrace
IMP	0.005±0.114 <sup>d</sup>	0.624±0.108 <sup>c</sup>	1.615±0.116 <sup>a</sup>	1.115±0.116 <sup>b</sup>	1.193±0.205 <sup>ab</sup>
ATP	0.007±0.048 <sup>c</sup>	0.132±0.045 <sup>bc</sup>	0.274±0.049 <sup>a</sup>	0.401±0.049 <sup>a</sup>	0.252±0.086 <sup>ab</sup>
ADP	1.590±0.121 <sup>a</sup>	0.647±0.114 <sup>b</sup>	0.343±0.123 <sup>b</sup>	0.560±0.123 <sup>b</sup>	0.748±0.218 <sup>b</sup>
AMP	0.097±0.009 <sup>ab</sup>	0.077±0.009 <sup>b</sup>	0.112±0.010 <sup>a</sup>	0.080±0.010 <sup>b</sup>	0.115±0.017 <sup>a</sup>
Flx	0.014±0.007 <sup>b</sup>	0.005±0.007 <sup>b</sup>	0.014±0.007 <sup>b</sup>	0.006±0.007 <sup>b</sup>	0.063±0.013 <sup>a</sup>
Ino	0.093±0.008 <sup>ab</sup>	0.047±0.008 <sup>c</sup>	0.105±0.008 <sup>a</sup>	0.050±0.008 <sup>c</sup>	0.077±0.015 <sup>bc</sup>

\* : Mean±S.E.

\*\* : pigs were fed for 6.5~7.5 months.

<sup>a,b,c,d</sup> : means within the same row without the same superscript letters are significantly different (P < 0.05).

ND : Not detected, ; TR : Trace.

**Table 3: Comparison of free amino acid (mg/100g) \* in pork loin \*\* from different breeds \*.**

Items/Breed	Black	Hybrid	Duroc	Yorkshire	Landrace
Asp	4.65±1.48	5.87±1.21	4.13±1.70	5.36±1.32	4.30±1.48
Thr+Ser	28.87±4.82	20.60±3.77	19.11±5.33	21.10±5.65	24.96±5.65
Glu	21.05±4.65	14.31±3.63	10.43±5.14	13.99±4.45	12.83±5.45
Gly	12.29±1.65	9.72±1.29	8.94±1.82	9.73±1.93	8.49±1.93
Ala	23.28±3.54	19.54±2.76	19.30±3.91	18.11±4.15	16.46±4.15
Cys	ND	TR	TR	TR	TR
Val	9.67±1.62	6.91±1.27	6.28±1.79	7.65±1.90	6.73±1.90
Met	3.91±1.12 <sup>ab</sup>	6.91±1.12 <sup>a</sup>	2.68±1.29 <sup>b</sup>	1.98±1.42 <sup>b</sup>	3.25±1.29 <sup>b</sup>
Ile	7.82±1.55	5.04±1.21	4.07±1.71	4.78±1.81	4.43±1.81
Leu	13.41±2.65	8.62±2.07	7.14±2.93	7.51±3.11	7.76±3.11
Tyr	8.65±1.63	6.08±1.27	4.43±1.91	5.66±1.91	5.29±2.04
Phe	10.20±2.08	8.64±2.08	4.16±2.36	5.65±2.55	7.88±2.80
His	7.60±1.36	5.55±1.07	6.69±1.51	5.10±1.60	5.09±1.60
Lys	12.33±2.82	8.40±2.20	6.69±3.11	10.00±3.30	9.95±3.30
Arg	10.07±2.10	6.29±1.64	4.37±2.32	6.86±2.46	7.11±2.46
Total	167.93±31.14	120.59±23.34	103.61±34.43	119.66±36.51	117.94±36.51

\* : Mean±S.E.

\*\* : pigs were fed for 6.5~7.5 months.

<sup>a,b</sup> : means within the same row without the same superscript letters are significantly different (P < 0.05).

**Table 4: Comparison of free glucose and ribose (mg/100g) \* in pork loin \*\* and ham from different breeds.**

Part	Items/Breed	Black	Hybrid	Duroc	Yorkshire	Landrace
Loin	Glucose	114.36±7.45 <sup>b</sup>	93.91±6.00 <sup>b</sup>	145.74±8.48 <sup>a</sup>	36.29±8.48 <sup>d</sup>	104.11±8.67 <sup>bc</sup>
	Ribose	3.80±0.44 <sup>c</sup>	6.99±0.49 <sup>a</sup>	6.00±0.77 <sup>ab</sup>	4.11±0.69 <sup>bc</sup>	4.12±0.65 <sup>bc</sup>
Ham	Glucose	80.41±6.92 <sup>ab</sup>	64.78±5.37 <sup>b</sup>	92.35±7.83 <sup>a</sup>	30.71±7.83 <sup>c</sup>	38.40±7.75 <sup>c</sup>
	Ribose	3.42±0.42 <sup>b</sup>	6.95±0.43 <sup>a</sup>	6.93±0.92 <sup>a</sup>	4.18±0.59 <sup>b</sup>	3.64±0.55 <sup>b</sup>

\* : Mean±S.E.

\*\* : pigs were fed for 6.5~7.5 months.

<sup>a,b,c</sup> : means within the same row without the same superscript letters are significantly different (P < 0.05).

### Conclusions

Changes in ATP and its related compounds, free amino acids and free sugars, and pH value of pork are different among different breeds postmortem. They are affected by not only breed, but also sex, age and location of carcass and nutrition. Therefore, the factors affecting palatability of meat such as flavour and taste are very complicated.

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