

**EVALUATION OF PROCESSED MEATS USING RAT BIOASSAY,
IN VIVO AND IN VITRO PROTEIN DIGESTIBILITY TECHNIQUES**

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ABSTRACT

Local burgers and frankfurters were evaluated for protein quality using the rat bioassay for Protein Efficiency Ratio (PER), in vivo apparent digestibility and in vitro digestibility. All locally produced burgers showed PER values that were significantly lower ($P \leq 0.05$) compared to pure beef and 70:30 soy-beef references but higher than the mechanically deboned meat (MDCM) formulated burger. Local chicken frankfurters showed significantly higher ($P \leq 0.05$) PER value compared to an imported sample. Local chicken burgers showed significantly lower ($P \leq 0.05$) apparent digestibility compared to reference samples but higher than MDCM burger whereas local chicken frankfurters showed significantly higher ($P \leq 0.05$) value compared to the imported sample. Similar results with positive correlations were obtained with the in vitro enzymatic procedure for local burgers. Results from this study indicated that the protein nutritive value of the local burgers and frankfurters were generally low.

(*Key words: Processed Meats, Rat-PER, In Vivo, In Vitro Protein Digestibility*).

INTRODUCTION

In Malaysia, a significant entry has been made by fast food industry over the last ten years. Beside franchises such as MacDonald's, KFC and A&W, local production of fast food such as burger and frankfurter have been growing rapidly. However there are differences in the organoleptic properties, chemical composition, formulation, nutritional composition and overall acceptance of locally produced meat products compared to imported products. Babji et al (1984) reported that about 5 - 25% of protein added into processed meat were soy protein. Local frankfurters contained 23.5 - 71.7% meat, 15.5 - 36.5% soy protein, 0.9 - 27.4% added cereals and other ingredient such as egg, milk, sugar, MSG, garlic and ox fat (Babji et al, 1986). Currently, there are no reliable information available with regards to the nutritional status of locally produced burgers and frankfurters. This study compared the nutritive values of local burgers and frankfurters with casein and pure meat samples.

METHODS AND MATERIALS

Four locally produced burgers were selected with three reference formulations, i.e. pure beefburger, soy-beef mixture (70% beef and 30% hydrated textured protein) and 100% MDCM burger whereas locally produced chicken frankfurters were compared with an imported frankfurter. All samples were kept at -18°C until ready for further analyses.

Proximate Analysis

Protein, fat, moisture and ash were determined using the AOAC method (1984).

Rat Diet Preparation

Diet formulation was done using the procedure for PER as outlined by AOAC (1984), with casein (USBC) as reference protein. Each type of burger, frankfurter and casein diets were fed to eight male weanling rats (Sprague-Dawley Strain) obtained from the Animal Laboratory at UKM, Bangi, Selangor, Malaysia.

In vivo Apparent Protein Digestibility

Food consumption and fecal output data were recorded daily for eight days (day 10 - 18) of the 28 day study to determine the in vivo protein apparent digestibility.

In Vitro Protein Digestibility

The in vitro protein digestibility of various burgers and casein were measured using the AOAC method (1984). Casein^{AN} was used as a reference. The four enzyme systems used were α -chymotrypsin from bovine pancreas (type II), peptidase from porcine mucosa, trypsin from porcine pancreas (type IX) and protease from *Streptomyces grievus* (type XXI), purchased from Sigma Chemical Company. The in vitro protein digestibility, measuring pH reduction by the four enzyme system is done using the method in AOAC (1984).

Table 1 : Proximate Analyses of Local and Formulated Burgers.

Source	% Protein N x 6.25	% Fat	% Moisture	% Ash	% CH ₂ O + Crude Fiber
MDCM ^a	14.2 ± 1.1	18.7 ± 0.1	65.7 ± 0.2	1.3 ± 0.4	-
Ayamas ^b	15.8 ± 0.8	13.8 ± 0.3	67.1 ± 0.2	1.4 ± 0.2	-
DPP ^b	16.9 ± 0.5	15.0 ± 0.2	64.0 ± 0.2	2.0 ± 0.2	-
Ramly ^b	14.6 ± 0.3	25.3 ± 1.4	55.1 ± 0.1	1.6 ± 0.1	-
Pure ^c	19.4 ± 0.2	1.9 ± 0.0	78.9 ± 0.0	1.2 ± 0.0	-
70:30 ^c	18.2 ± 0.2	0.6 ± 0.0	77.1 ± 0.1	5.4 ± 0.0	-
Angus ^b	13.8 ± 0.2	24.6 ± 0.2	54.1 ± 0.2	2.2 ± 0.0	5.1 ± 0.6
Fika ^b	14.7 ± 0.2	25.4 ± 0.0	52.2 ± 4.6	2.4 ± 0.2	5.3 ± 0.0
Ramly ^b	13.5 ± 0.2	27.1 ± 0.1	51.2 ± 0.8	1.8 ± 0.1	6.4 ± 1.2
Thrifty ^b	11.3 ± 0.1	13.2 ± 0.1	56.5 ± 0.7	2.1 ± 0.2	17.1 ± 1.0

^a Mechanically deboned chicken meat

^b Local Brandname Burgers

^c Formulated Burgers

RESULTS AND DISCUSSION

The proximate analysis in Table 1 showed local burgers had lower protein content compared to

Table 2 : PER Values of Beefburgers, Chicken Frankfurters and Reference Samples.

Source of Protein	Adj. PER
Burgers	
Pure ^a	3.2
70:30 ^a	3.2
Angus ^a	2.4
Fika ^a	2.6
Ramly ^a	2.2
Thrifty ^a	2.9
100% Meat	2.4
MDCM	1.8
Ayamas	2.2
Ramly	2.1
DPP	1.9
Frankfurters	
A1	2.8 ± 0.2
DPP	2.0 ± 0.3
Doux	1.7 ± 0.4
Casein	1.2 ± 0.1

^a Babji and Selvakumari (1989)

Table 3 : % In vivo Apparent Digestibility of Local Burgers, Frankfurters and Reference Samples

Source of protein	% Apparent digestibility
Burgers	
Pure ^a	90.0 ± 0.6
70:30 ^a	87.9 ± 1.6
Angus ^a	85.5 ± 1.2
Fika ^a	86.2 ± 1.4
Ramly ^a	85.5 ± 2.0
Thrifty ^a	85.9 ± 0.8
Casein ^a	90.6 ± 1.8
100% Meat	75.0 ± 7.6
MDCM	74.4 ± 1.2
Ayamas	81.7 ± 2.2
Ramly	75.1 ± 2.0
DPP	81.0 ± 4.2
Casein	83.3 ± 2.8
Frankfurters	
A1	84.4 ± 7.4
DPP	81.0 ± 1.9
Doux	78.1 ± 8.6
Casein	93.9 ± 2.0

^a Babji and Selvakumari (1989)

showed the in vivo apparent digestibility of local burgers and frankfurters. Pure beefburger had the highest value of 90.0% in the 1989 study. However, in this study local burgers had lower digestibility values compared to the reference samples. Local burgers from earlier study also showed low vivo apparent digestibility. In vivo apparent digestibility of local and imported chicken frankfurters are shown in Table 3. The lower digestibility of chicken frankfurter compared to reference casein (93.9%) may be due to addition of soy protein. Local frankfurters have higher digestibility value 84.3% (A1) and 81.0% (DPP) compared to the imported frankfurters, Doux (78.1%). Table 4 showed that in vitro protein digestibility of locally formulated burgers were lower than casein reference (Babji and Selvakumari, 1989). Among the burgers studied, the pure burger had the highest value at 85.6% followed by the 70:30 mixture at 84.8%.

CONCLUSION

These studies indicated that local burgers are generally lower in protein quality compared to the reference samples. Protein content was lower because of possible substitution with carbohydrate components for meat replacement. Locally processed burgers had lower PER values than the pure beef and soy-beef (70:30) burgers. Local chicken frankfurter showed slightly higher PER value compared to the imported sample as well as the reference sample. Locally produced burgers, chicken frankfurters and imported frankfurter also had lower in vivo digestibility, indicating some poorly digested components added to the formulation.

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pure and 70:30 beef-soy protein burgers. The value of pure and soy-beef burgers were similar to A&W (19.43%), Wendy's (17.17%) and MacDonald's (18.58%) as reported earlier by Babji et al (1985). It was also observed that Thrifty burger had the lowest protein content of 11.3%. The lower protein content in local samples suggested the addition of non-protein binders such as carbohydrate in the formulation. PER values for rats fed local and formulated burgers and frankfurters are shown in Table 2. The PER values for local burgers was significantly lower ($P \leq 0.05$) ranging from 1.9 to 2.4 compared to burgers and two references samples from another study by Babji & Selvakumari (1989). PER value for MDCM burger was the lowest compared to others. The PER value for A1 frankfurter is higher compared to DPP and Doux brand. Differences of PER values of the samples could be due to the quality of protein present in the frankfurters. In many countries nonmeat protein such as milk and soybean are often added into the formulation. Table 3

Table 4 : In Vitro Protein Digestibility of Locally Formulated Beefburgers

Protein Source	% In Vitro Digestibility ^a
Pure	85.6 ± 3.6
70:30	84.8 ± 4.2
Angus	82.9 ± 4.2
Fika	83.3 ± 5.6
Ramly	82.6 ± 4.2
Thrifty	83.6 ± 4.6
Casein	87.4 ± 3.0

^a Means and Standard deviation from three samples. Source: Babji and Selvakumari (1989)