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Input and Output of Energy in Processing Gizzard Pickle

A.K. SACHDER, K.P. MISHRA*, RAM GOPAL and S.S. VERMA
Central Avian Research Institute
Izatnagar 243. 122, India

** C.I.R.C.*
Mukhdoom, India

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ABSTRAK

Data dikumpul dari tujuh contoh untuk menentukan input tenaga komersil dalam pemprosesan jeruk daging ayam secara manual berasaskan minyak dan juga yang berasaskan cuka (VB) serta out put nilai-nilai kalori daripada pengeluaran yang juga diambil kira. Sejumlah elektrik (0.691 kWh) dan tenaga (9.792 MJ) yang lebih tinggi dengan input tenaga manusia yang sedikit diperlukan dalam menyediakan jeruk berasaskan cuka jika dibandingkan yang berasaskan minyak (0.597 kWh) dan 8.731 MJ/kg daging mentah). Walau bagaimanapun, lebih output kalori diperolehi dari pengeluaran berasaskan minyak (282 Cal/100 g) berbanding dengan jeruk berasaskan cuka (261 Cal/100 g). Walaupun kelebihan jeruk daging berasaskan minyak ini adalah pada warna, kebasahan dan kelembutannya, namun penerimaan menyeluruh terhadap jeruk ini ternyata berbeza. Analisis kehampiran menunjukkan variasi dalam pH, kandungan kelembapan dan protein mentah dalam kedua-kedua jeruk adalah tidak jelas. Berasaskan hubungan tenaga input output, disimpulkan bahawa pemprosesan jeruk daging berasaskan cuka adalah lebih ekonomik dari segi kos (67 Cal/rupee) berbanding jeruk daging ayam berasaskan minyak (56 Cal/rupee).

ABSTRACT

Data were collected from seven replicates to quantify the input of commercial energy in manual processing of oil-based (OB) as well as vinegar-based (VB) chicken gizzard pickles and output of caloric values from the products was calculated. Higher amounts of electrical (0.691 kWh) and total energy (9.792 kWh) with lesser inputs of human energy were required in preparation of VB pickle compared with 0.3 (0.597 kWh) and 8.731 MJ/kg of raw gizzard products. However, more caloric outputs were obtained from OB product (282 Cal/100g) compared with VB (261 Cal/100g) pickle. Despite significant superiority of oil-based gizzard pickle for colour, juiciness and tenderness, the overall acceptability of pickles was insignificantly different. Proximate analysis revealed nonsignificant variations in pH, moisture content and crude protein of the two pickles. Based on the input output energy relations, it is concluded that processing of experimental VB gizzard pickle is economically cost effective (67 Cal/rupee) over the oil-based (56 Cal/rupee) chicken gizzard pickle.

INTRODUCTION

With the growing popularity and demand for fast foods, it is becoming obligatory for the industry to spend higher exchange rates for energy inputs required in preparation of desired products. A substantial amount of information has been published on application of energy in food processing (Unger 1975; Schwartzberg 1977; Carroad *et al.* 1980; Ostrander 1980; Singh and Dhingra 1987). Various studies were also made on the preparation and storage of gizzard pickles (Arfa 1977; Charoenpong and Chen 1980; Sharma *et al.* 1986), but no work has so far been reported on the energy utilization patterns in the processing of pickled gizzards. In view of the need for such information, data have been collected through methodical evaluation and audit on quantification in input energy during processing of chicken gizzard pickles and a comparative study has been made on the cost effectiveness of two pickles in relation to the output of the caloric energy yields.

MATERIALS AND METHODS

A total of seven replicates utilizing 63.6 kg of gizzards, collected from the pilot poultry processing plant of the Central Avian Research Institute, were prepared by removing the adipose tissue and slicing each gizzard into 3-4 pieces. The oil-based (OB) and vinegar-based (VB) pickles were made using the procedures of Chatterjee *et al.* (1969) and Panda (1988). Formulations are given in Table 1. While processing the products, condiments were weighed on a Sartorious top-pan electronic balance. The frying of condiments was undertaken by using a 1500W hot plate. Gizzards were pressure cooked (15 lb/inch^2) for 10-12 minutes. Cooked gizzards were separated and the water discarded.

Estimation of Input Energy

The labour force comprised an unskilled adult man. Quantification of human energy (hE), electrical inputs (EI) and total energy (TE) was calculated by the following formulae:

$$\text{Manhour (hE)/kg of raw gizzards} = \frac{\text{Average time taken in the process}}{60 \times \text{Average quantity of gizzards processed}}$$

$$\text{EI (kWh)} = \frac{\text{Watt (W)} \times \text{Time (min)}}{1000 \times 60}$$

$$\text{EI/kg raw gizzards} = \frac{\text{kWh}}{\text{Average quantity of gizzards processed}}$$

TE (total energy) was determined from hE and EI by using the following standards (Panesar and Bhatnagar 1987):

1 manhour/kg = 1.96MJ
1 kWh/kg = 11.93 MJ

Output Energy

The nutritional energy (Cal/100g) of pickles was determined using the formula of Shackelford *et al.* (1989)

Sensory and Physico-chemical Traits

Sensory properties including colour, flavour, juiciness, tenderness, texture and overall acceptability of OB and VB pickles were estimated after 72 hours of ageing at ambient temperature. Seven experimental panellists from the professional staff of the institute were requested to judge the products for the above traits on the

TABLE 1
Formulation of gizzard pickle per kilogram of gizzards

Oil-based		Vinegar-based	
Ingredients	Quantity (g)	Ingredients	Quantity (g)
Table salt	38.0	Table salt	90
Sodium nitrite	0.2	Peeled garlic	32
Monosodium glutamate	0.5	Peeled ginger	32
Red chilli	15.0	Cumin	6
Black pepper	8.0	Red chilli	6
Caraway	3.0	Aniseed	3
Clove	1.0	Caraway	3
Cinnamon	1.0	Cinnamon	2
Pelled garlic	6.0	Clove	2
		Turmeric	3
		Black pepper	2
			ml
Vinegar	190.0	Refined mustard oil	10
Refined mustard oil	200.0	Vinegar	195
		Water	195

10-point Hedonic scale. In all seven replicates, pH was measured by a ELICO pH meter as per AOAC (1985). Shear force of the pickled gizzards was determined in lb/inch^2 by using Warner Bratzler Shear Press (Model 13806). Moisture, crude protein and ether extract (EE) were estimated as per AOAC (1985). A minimum of three samples was taken for recording observations of these traits for each replicate.

Cost of Production

Based on the input energy consumed in processing chicken gizzard pickles, prevailing market rates, bank interest (15% per annum), depreciation on appliances (8%) and cost of raw gizzards (Rs.12.00 per kg), the cost of production for OB and VB pickles was calculated. However, fluctuations in rates at various locations and other market conditions cannot be overlooked.

Statistical Analysis

Data related to time consumed for common steps of processing the two products were subjected to 't' tests for determination of significant differences. Observations on proximate analysis were transformed into arcsine values prior to statistical analysis. Data on sensory traits were subjected to statistical corrections before adoption of standard procedures by Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

Input Energy

The means ± SE of the human energy (hE) consumed at various steps of processing OB and VB gizzard pickles are presented in Tables 2 and 3. The basic data on time taken were converted into manhour/kg as well as total energy required for the purpose. Obviously, maximum time was utilized for cooking,

TABLE 2
Energy consumption profile in processing of oil-based gizzard pickle

Parameters	Time taken *(min/4.56 kg)	%	Manhour/ (kg)	Energy consumption (MJ/kg)
A *Human Energy*				
1. Cleaning and slicing of gizzards	51.43 ± 4.48	22.78	0.188	0.368
2. Weighing condiments	23.57 ± 0.85	10.43	0.086	0.169
3. Putting gizzards in vinegar	30.00 ± 0.00	13.28	0.109	0.214
4. Frying condiments	38.14 ± 2.54	16.76	0.139	0.272
5. Cooking of gizzards	53.57 ± 2.61	23.72	0.195	0.382
6. Separating cooked gizzards	10.86 ± 0.82	4.80	0.039	0.076
7. Heating pickle	12.14 ± 1.02	5.38	0.044	0.086
8. Tranferring pickle to glass jar	6.43 ± 0.44	2.85	0.022	0.043
Total	226.14	100.00	0.822	1.610
B. *Electrical Energy*	kWh	% kWh	kWh/kg	MJ/kg
1. Frying condiments	0.96	35.29	0.211	2.517
2. Cooking gizzards	1.45	53.31	0.318	3.793
3. Heating pickle	0.31	11.40	0.068	0.811
Total	2.72	100.00	0.597	7.121

Grand total energy consumed 8.731 MJ/kg
* Mean ± standard error

TABLE 3
Energy consumption profile in processing of oil-based gizzard pickle

Parameters	Time taken *(min/4.53 kg)	%	Manhour/ (kg)	Energy consumption (MJ/kg)
A *Human Energy*				
1. Cleaning and slicing of gizzards	51.42 ± 4.80	23.93	0.189	0.370
2. Weighing condiments	21.42 ± 0.85	9.98	0.079	0.155
3. Heating vinegar and water	17.14 ± 1.37	7.98	0.063	0.123
4. Frying condiments	19.28 ± 2.12	8.98	0.071	0.139
5. Preparation of pickle solution	36.57 ± 1.82	17.03	0.135	0.265
6. Cooking of gizzards	51.42 ± 1.94	23.93	0.189	0.370
7. Separating cooked gizzards and putting in pickle solution	12.14 ± 0.93	5.65	0.045	0.088
8. Tranferring pickle to glass jar	5.42 ± 0.27	2.52	0.020	0.039
Total	214.81	100.00	0.791	1.549
B. *Electrical Energy*	kWh	% kWh	kWh/kg	MJ/kg
1. Heating vinegar and water	0.43	13.74	0.095	1.133
2. Frying condiments	0.49	15.65	0.108	1.288
3. Preparation of pickle solution	0.92	29.40	0.203	2.422
4. Cooking of gizzards	1.29	41.21	0.285	3.400
Total	3.13	100.00	0.691	8.243

Grand total energy consumed 9.792 MJ/kg
* Mean ± standard error

followed by cleaning and slicing raw gizzards. However, there were no significant variations in time consumed for common steps *viz.* cleaning and slicing of gizzards; weighing and frying of condiments; cooking gizzards and transferring pickle into glass jars with plastic lids. Differences in hE requirements for the two pickles were probably due to variations in formulation procedures.

EI requirements were significantly ($P<0.05$) higher for VB than OB pickle (Tables 2 and 3).

TE requirements (sum of hE and EI) were higher for processing VB (9.72 MJ/kg raw gizzards) than OB (8.731 MJ/kg) gizzard pickle.

Output Energy

Calculations revealed higher caloric output from OB (282 Cal/100 g) pickle than VB product (262 Cal/100 g). The obvious reasons reason is the greater amount of fat available in oil-based gizzard pickle

Sensory and Physico-chemical Traits

Significant differences were observed in colour, juiciness, tenderness, shear force value and EE of the OB and VB pickles (Table 4). However, no significant variations were recorded for flavour, texture, overall aceptability, pH moisture and CP.

TABLE 4
Means ± SE of sensory and physico-chemical characters in chicken gizzard pickle

Parameters	Gizzard Pickle					
	Oil-based			Vinegar-based		
1. Colour	7.55	±	0.22[a**]	6.48	+	0.14[b]
2. Flavour	6.78	±	0.26	6.73	+	0.17
3. Juiciness	7.30	±	0.21[a*]	6.45	+	0.19[b]
4. Tenderness	7.28	±	0.20[a*]	6.44	+	0.30[b]
5. Texture	7.02	±	0.15	6.50	+	0.23
6. Acceptability	7.04	±	0.19	6.58	±	0.25
7. pH	4.71	±	0.13	4.33	±	0.18
8. Shear force (lb/inch^2)	3.06	±	0.21[b*]	4.01	±	0.25[a]
9. Moisture	50.95	±	0.33	51.24	±	0.45
		(60.30)			(60.80)	
10. Crude protein (CP)	27.83	±	0.38	27.97	±	0.29
		(21.80)			(22.00)	
11. Ether extract (EE)	19.45	±	1.76[a**]	11.51	±	1.10[b]
		(11.10)			(4.00)	

Figures bearing same or no superscripts did not differ significantly for treatment effects. Observations at S1. No. 9, 10 & 11 are analysed in arcsine values. Percentages are reported in parenthesis.

Coast of Production

Based on the standards already mentioned and cost of input energy, the coast of producing OB gizzard pickle was higher than that of VB pickle. The main contributor to this effect was the cost of additional mustard oil. Comparioson of input output energies from the two kinds of pickles revealed higher yield of calories per Indian rupee from VB (67 Cal) than OB gizzard pickle (56 Cal).

CONCLUSIONS

Observations were recorded on the input and output energies of oil-based as well as vinegar-based chicken gizzard pickle. Results showed that processing of VB pickle required lower amounts of human and electrical inputs and resulted in more nutritional energy per rupee. Therefore processing of VB chicken gizzard pickle is more cost effective than oil-based gizzard pickle.

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REFERENCES

AOAC. 1985. *Official Methods of Analysis.* 14th edn. Washington, D.C.: Association of Official Analytical Chemists.

ARFA, A.S. 1977. Pickled chicken gizzards. I. Acceptability and proximate analysis. *Poultry Science* **56:** 1014-1017.

CARROAD, P.A., R.P. SINGH, M.S. CHINNAN, N.L. JACOBS and W.W. ROSE. 1980. Energy use quantification in canning of cling stone peaches. *Journal of Food Science* **45:** 723-733.

CHAROENPONG, C. and T.C. CHEN. 1980. Qualities of pickled chicken gizzards as affected by salt and vinegar. *Poultry Science* **59:** 537-542.

CHATTERJEE, A.K., P.C. PANDA and V.S. KHABADE. 1969. Poultry pickle. *Food Industry Journal.* **3(8):** 11-13.

OSTRANDER, C.E. 1980. Energy use in agriculture poultry. In *Handbook of Energy Utilization in Agriculture* ed. D. Pimental. Boca Raton: CRC Press Inc.

PANDA, B. 1988. Charda oration lecture. Delivered at Bombay Veterinary College, Bombay in August 1988: 10-11.

PANESAR, B.S. and A.P. BHATNAGAR. 1987. Energy norms for inputs and outputs of agriculture sector. In *Proceedings of National Conference on Energy in Production, Agriculture and Food Processing*, October, 30-31, 1987 held at PAU, Ludhiana, India.

SCHWARTZBERG, H.G. 1977. Energy requirements for liquid food concentrate. *Food Technology* **21:** 67-76.

SHACKELFORD, S.D., J.O. REAGAN, T.F. MANN, C.F. LYON and M.F. MILLER. 1989. Effects of blade tenderization, vacuum massage time and salt level on chemical, textural and sensory characteristics of precooked beef chuck roasts. *Journal of Food Science.* **54:** 843-845.

SHARMA, B.D., R.C. KESHRI, G.S. PADDA and N. SHARMA. 1986. Processing and acceptability of chicken gizzard pickle and chutneys. *Cheiron* **15:** 123-125.

SINGH, Y. and D.P. DHINGRA. 1987. Energy conservation studies in food processing. In *Proceedings National Conference on Energy in Production, Agriculture and Food Processing.*

SNEDECOR, G.W. and W.G. COCHRAN. 1967. *Statistical Methods.* 6th edn. Calcutta: Oxford and IBH Publishing.

UNGER, S.G. 1975. Energy utilization in the leading energy consuming food processing industries. *Food Technology* **29(12):** 33-45.

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