Pak. j. sci. ind. res., vol. 32, no. 4, April 1989

SCIENTIFIC STUDY AND DEVELOPMENT OF MEAT BARIAN – A TRADITIONAL FOOD PRODUCT

Part III. Study of Different Processing and Drying Methods

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(Received September 20, 1988; revised March 8, 1989)

Part III of this study deals with the selected formulations of 'Barian' made from dal mash, mung with the use of 25% beef in the fresh state. Three methods of drying, namely (i) open sun (ii) in solar dryer (iii) mechanical drying using natural gas, have been tested for the quality of the dried product. Drying temperature of 70° and mechanical drying proved to be the most quality effective means. The nutritional and biological evaluation, carried out by the measurement of available lysine, vitamins B_1 and B_2 and rat trials proved again in favour of mechanically dried 'Barian'. The microbiological testing, after drying by the three methods, as well gave the most hygienic product in case of natural gas drying.

Key words: Pulses, Meat, Barian.

INTRODUCTION

Changes have been observed in Pakistan particularly in the urban areas both in the patterns and type of food consumed. 'Barian" is one of the traditional rural food item of Pakistan which is losing its popularity. A large portion of younger generation may not have even heard of this food item. The use of 'Barian' and other similar food items need to be revived. 'Barian' is a relatively low cost food item and needs to be reintroduced as one of the food items of daily use. The exact reasons of its diminishing use has to be found out. Because of rising costs and hygienic problems, the practice of using mutton in 'Barian' is not as common as it once was. By incorporating beef into the 'Barian', the protein content of this food product can be greatly enhanced and its use made wider.

In our last studies [1, 2] in which we have concluded dal mash 'Barian' as the best, due to the greater binding capacity and also because the people have a traditional concept of its use as a base in 'Barian'. The product was tested for its chemical, nutritional and sensory parameters during the stages of development and processing. Three different drying methods namely open sun (S), solar dryer (Sd) and natural gas dryer (NG) were used to determine their effect on the dried product.

MATERIALS AND METHODS

Barian-making. The material and method of making 'Barian' was the one described in an earlier publication [2]. Meat pulses 'Barian' were prepared using different percentages of meat (beeflo) and pulses. The selection of different combinations of beef and pulses [2] were based on the following four considerations.

(1) Remarks obtained on organoleptic testing.

(2) Rehydration studies.

(3) Economic suitability, keeping in view the price of different pulses and fresh beef.

(4) Examination and comparison with the traditional products obtained from the market.

In case of pulses four different pulses were used i.e. dal mash (*Phaseolusomungo* – black gram), mung (*Phaseolus aureus* – Green Gram), gram (*Cajanus indicus* – Red Gram), lentils (*Lense esculenta* – lentils). All of these pulses were purchased in big lot either from main grain market of the city or from the nearby general stores. All other ingredients, such as condiments etc. were of the National Food Products Ltd. Karachi.

Drying. In order to investigate the potential of solar energy in comparison with natural gas, which are both abundantly available in Pakistan, it was thought to dry selected formulations of 'Barian' by the three methods.

(a) Open sun drying (S)

(b) In solar dryer (Sd)

(c) Natural gas drying (NG)

The mechanical drying was based on the use of natural gas (NG).

Altogether it amounted to three different drying methods. Another experiment was performed to study drying time of 'Barian' of different combinations at different temperatures. In this study an electrical compact cabinet drying unit of M/s. Mitchell Dryer of Manchester, U.K. was used to monitor the drying rates at different drying temperatures. Air velocity changes were also introduced locally by modification in the forced air system of the cabinet dryer.

The details of open sun drying and solar dryer have been given in Part II [2] of this study. The natural gas drying was based on the use of pilot scale tunnel dryer made in these laboratories for the large scale vegetable dehydration. As far as possible the drying temperature was kept around 65-70°. The temperature during open sun and solar drying were however, dependent on the weather conditions at the time of drying.

Barian code. For the convenience of expression the following codes have been used in this paper.

(1) S1X-open sun dried mash with 25% beef. (2) S2X-open sun dried mung with 25% beef. (3) Sd1X-solar dryer mash with 25% beef. (4) Sd2X-solar dryer mung with 25% beef. (5) NG1X-natural gas dried mash with 25% beef. (6) NG2X-natural gas dried mung with 25% beef.

Biological evaluation. It was carried out by rat trials using groups of 4 rats each, in duplicate. Rats were taken at their weaning age weighing between 40-50 g each. The experiment was run for 28 days with feed and water adlibitum. Weight gain was measured on alternate days and faeces collected weekly.

RESULTS AND DISCUSSIONS

1. *Pulses and beef combinations.* From different combinations of pulses the two dals, mash and mung gave the best product [2]. The experimental results of the rehydration studies (Table 1) supported this selection. 'Barian' made of dal gram and/or lentils broke down quickly, during cooking/rehydration while those of dal mash maintained their shape well.

Based on our previous study [2] with respect to beef incorporation in 'Barian' and from this prevalent economic considerations, which are highly important, the use of beef (Beeflo) beyond 30% did not appear advisable. The price of the product would than become to high in comparison to market product and additionally the people may identify such meat 'Barian' with distance from the traditional ones.

Table 1. Comparison of the rehydration studies of beef-pulses product (Barian) made in the laboratory (wet method) with market samples (rehydration time 2 hrs).

Serial	Combination of pulses (%)	Fresh beef form used (%)	Forming/ casting	Rehydration ratio
1.	Mash (44) + gram (19)	Minced (37)	Machine	1.50
2.	Mash (44) + lentile (19)	"	"	1.51
3.	Mash (63)	"	"	1.50
4.	Mash (44) + gram (19)	"	Manual	1.63
5.	Mash (44) + lentile (19)	"	"	1.73
6.	Mash (63)	"	"	1.71
7.	Market sample No. 1	Nil	"	1.52
8.	Market sample No. 2	Nil	"	1.24
9.	Market sample No. 3	Nil	"	Broken down
10.	Market sample No. 4	Nil	"	1.42
11.	Market sample No. 5	Nil	"	Broken down
12.	Market sample No. 6	Nil	"	1.36

Rehydration ratio At ambient temp. ≃ 25° = $\frac{\text{Final wt. of the product (after seaking in water)}}{\text{Initial wt. of the product}}$

2. *Temperatures of drying.* Temperatures between 60° and 100° were used to dry the product, sometime with varying air-velocities in the electric dryer. Table 2 describes temperature and time of drying in respect of six types of pulses-beef combinations. The time of drying decreased with increasing the temperature but temperature beyond 70°started affecting the color and hardening of the outer surface. Air velocity changes did not show significant difference in the time of drying at any one temperature. Best results were obtained at 70° with regard to visual raw quality of 'Barian' which is most important single factor to promote any packaged food product.

Table 2. Drying time and temperatures for Barian made from different dals and with different %ages of beef (cabinet dryer - electrical).

S. No..	Temperature (°C)	Drying time: 25% Beef Mash (hr)	25% Beef Mash + gram (hr)	25% Beef Gram (hr)	50% Beef Mash + (hr)	50% Beef Mash + gram (hr)	50% Beef Mung (hr)
1.	60	18	14	14	10	13	15
2.	70	13	12	12	10	10	10
3.	80	13	10	10	10	9	8
4.	90	9	9	9	8	9	8
5.	100	6	6	6	7	8	7

1. Each batch studied was about 8 kg wet weight.
2. Varying the rate of air velocity to high,medium and low made insignificant affect on drying rate at any one temperature.

3. *Drying methods.* Solar energy and natural gas are both abundantly available in Pakistan. Table 3 describes the effect of three different drying methods in respect of time and some visible qualities of the product. Open sun drying (S1X, S2X) due to its prolonged exposure to sunlight (IR, visible and UV range of wavelength) and environment resulted in dull colored and dirty product. Natural variations in relative humidity of the atmosphere have strong influence on the drying time, and the end-product moisture-level. In respect of drying time, our experience was similar to the rural and commercial producers of 'Barian' who informed that 3-5 sunny days are needed to dry them. If the weather was cloudy or it rained, there was a high chance of development of off-flavours in, and the spoilage of the product. Open sun drying was also open to attack by insects rodents and even birds. To guard against the uncertainties of the weather, the rural/commercial producers usually spread their lot of 'Barian' every morning in the sun and recollect in the evening so as to place them under the roof in the night.

Drying of the two types of 'Barian' (Sd1X, Sd2X) in the laboratory made solar dryer [2] took about one to half day less time than the open sun drying. Although this difference is sizeable on the average, yet it was significant only in case of very sunny days having very low relative

Table 3. Effect of three different drying methods on beef/pulses Barian (beef 25% in all cases).

No.	Sample Code	Code explanation	Temperature range during driving (°C)	Drying time	Visual inspection
1.	S1X	Open sun drying (mash)	30°-55°	3 days or more	Slightly dull color with lot of dust particles.
2.	S2X	Open sun drying (mung)	-do-	-do-	
3.	Sd1X	Solar dryer (mash)	40°-80°	2-2-1/2 days	Slightly darkish and glazy in case of dal mung
4.	Sd2X	Solar dryer(mung)	-do-	-do-	
5.	NG1X	Forced air natural gas drying (mash)	65°	8-9 hours	Best drying and best color amongst all brownish red tinge of dal mung was likeable.
6.	NG2X	Forced air natural gas drying (mung)	-do-	-do-	
7.	Commercial samples (no beef)	Open sun dried	Unknown	3-5 sunny days	A big variety in color, shape, size and spoilage-type.

1. The data on commercial sample is based on verbal enquiries.
2. The range of values is based upon several repetitions.

humidity. The temperature in the solar dryer, ranged between 40 and 80° and was not sharply controlable by its air inlets. The high side of temperature resulted in affecting the color of dried product to some extent. The colour change was due to the accelerated non-enzymatic browning [3]. Best results were however, obtained in the mechanical dryer (NG1X, NG2X) at about 70° with forced air circulation system.

Table 4. Proximate analysis of market/commercial samples.

S. No.	Protein (%)	Fat (%)	Ash (%)	Fibre (%)	Moisture (%)
1.	25.68	1.24	9.03	1.44	10.26
2.	26.37	1.40	11.11	1.40	6.53
3.	17.69	1.26	10.78	1.38	7.66
4.	25.9	1.91	7.75	1.78	10.50
5.	24.25	1.90	7.85	1.09	11.85
6.	17.63	1.10	9.03	1.97	9.4
7.	19.25	1.58	8.35	1.34	9.75
8.	23.25	2.10	7.98	1.53	9.05

1. All analyses carried out according to "Official Methods of Analysis". Association of Official Analytical Chemists, (Washington D.C. 1984).

The examination of the proximate analysis (Table 4) revealed that dal mash, whether present in laboratory made or commercial sample of 'Barian' slightly enhanced the percentage of protein in 'Barian'. The moisture level at the end of drying varied from 6.35 to about 9.0% in the case of laboratory made meat 'Barian' while it was somewhat higher for the market samples. fibre matter in the laboratory samples was comparatively less than the commercial samples. The use of dal mash or mung however, made no difference for the fiber content. The fat percentage was lower in the commercial samples.

Microbiology and drying methods. The microbiological quality of six different formulation was examined for TVC, coliforms, *Salmonellae, Shigellae, Staphylococcus* spp. after the drying was complete (Table 5). Highest contamination was observed in the open sun dried samples

Table 5. Microbiological examination of Barian dried by different drying methods.

Type of tests	Open sun		Solar dryer		Natural gas	
	S1X	S2X	Sd1X	Sd2X	NG1X	NG2X
TVC	Uncountable	Uncountable	7.2×10^4	3.7×10^4	3.0×10^4	2.1×10^4
Coliform	+ve metallic sheep present	-ve	-ve	-ve black and white fungus	-ve	-ve
Salmonella	-ve	-ve	-ve	-ve	-ve	-ve
Shigella	-ve	-ve	-ve	-ve	-ve	-ve
Staphylococcus sp.	-ve	-ve	-ve	-ve	-ve	-ve

All samples were tested as soon as their drying was complete.

Table 6. Microbiological examination of commercial market samples of Barian.

S. No.	Locality	TVC	*Coliform*	*Salmonella*	*Shiqella*	*Staphylococcus* sp.
1.	Kot Radha Kishan	9.8×10^6	+ve fungus	-ve	-ve	-ve
2.	Raiwind	Uncountable	-ve	+ve	-ve	-ve
3.	Kasur	"	-ve	-ve	-ve	-ve
4.	Sheikhupura	9.1×10^7	+ve	-ve	-ve	-ve
5.	Sharqpur	Uncountable	+ve fungus	-ve	-ve	-ve
6.	Muridke	"	+ve	-ve	-ve	-ve
7.	Lahore	8.1×10^7	-ve fungus	+ve	-ve	-ve
8.	Lahore	Uncountable	+ve	-ve	-ve	-ve
9.	Lahore	1.31×10^7	+ve	-ve	-ve	-ve
10.	Lahore	1.4×10^8	-ve fungus	-ve	-ve	-ve
11.	Multan	Uncountable	+ve fungus	-ve	+ve	-ve
17.	Multan	"	-ve	+ve	-ve	-ve
13.	Rawalpindi	8.1×10^6	-ve-	-ve	-ve	-ve
14.	Rawalpindi	7.7×10^7	-ve	-ve	-ve	-ve
15.	Rawalpindi	6.5×10^6	+ve fungus	-ve	-ve	-ve
16.	Karachi	Uncountable	-ve	-ve	-ve	-ve

None of the market samples was available having any kind of meat in it.

(S1X and S2X). It is noteworthy that sun drying is the only method applied commercially for drying of 'Barian' and these findings support the highly contaminated nature of market/commercial samples (Table 6). Laboratory made open sun dried samples, showed positive coliform in some cases but such discovery was a common occurrence in the market samples. The solar dryer and mechanically (NG) dried samples showed negative results for all types of pathogens tested and a low profile in respect of TVC. It is, therefore, concluded that the products dried on the natural gas dryer should be most hygienic.

Drying methods and nutritional losses. Table 7 describes the amounts of available lysine [4], vitamins [5] B_1 and B_2/100 gm after drying of the six selected meat/pulses 'Barian'. Maximum losses of the nutrients occurred during their prolonged exposure to sunlight in the open sun drying (S1X, S2X) and the minimum were noted in the case of mechanically dried products (NG1X, NG2X). Least drying time (8-9 hours) appeared responsible for the least nutrient losses in the forced air mechanical drying. It is already known that the prolonged exposure to heat destroyes the nutrients and it happened in the case of open sun drying which required a very long drying time. Different wavelengths (IR, visible and UV) present in the sunlight cause the break down of the labile molecules of these nutrients.

Table 7. Effect of different drying methods on the nutritional components of beef/pulses Barian.

Samples	Available lyaine [4] (gm/100gm sample)	Vitamin B_1 [5] (mg/100gm sample)	Vitamin B_2 [5] (mg/100gm sample)
S1X	1.12	255	190
S2X	1.01	280	193
Sd1X	1.21	260	220
Sd2X	1.05	290	215
NG1X	1.31	275	215
NG2X	1.15	295	224

1. The values are average of duplicate samples.
2. For estimation methods, refer to No. 4 and 5 in references.

Biological evaluation of beef-pulses 'Barian'. Table 8 describe the results of biological evaluation of the forced air mechanically dried dal mash and mung Barian having

Table 8. Biological evaluation of wheat flour containing different percentage of 'Barian' compared with commercial samples.

No.	Diat (wheat floor containing)	Protein in the diet (%)	Net weight gain (gm)	PER [4]	Food efficiency
Dal Mash					
1.	10% NG1X (lab. sample)	12.63	166.00	1.33	6.44
2.	20% NG1X (lab. sample)	15.13	186.00	1.33	5.23
3.	30% NG1X (lab. sample)	17.00	210.00	1.29	4.61
Dal Mung					
4.	10% NG2X (lab. sample)	12.80	150.00	1.22	6.42
5.	20% NG2X (lab. sample)	14.60	170.00	1.27	5.40
6.	30% NG2X (lab. sample)	16.40	207.00	1.32	4.62
Commercial sample					
7.	10% Barian (commercial)	14.50	128.00	0.93	7.42
8.	20% Barian (commercial)	16.50	114.00	0.73	8.28
9.	30% Barian (commercial)	17.50	128.00	0.94	6.07

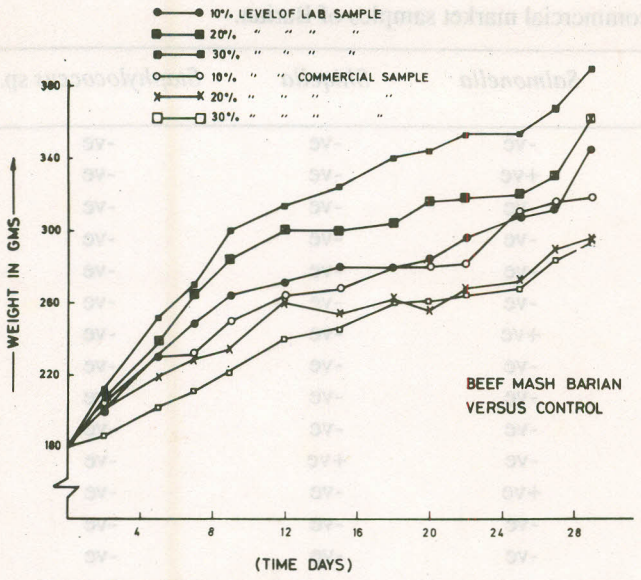

Fig. 1. Growth curves of rats using beef-mash barian against the market samples used as control.

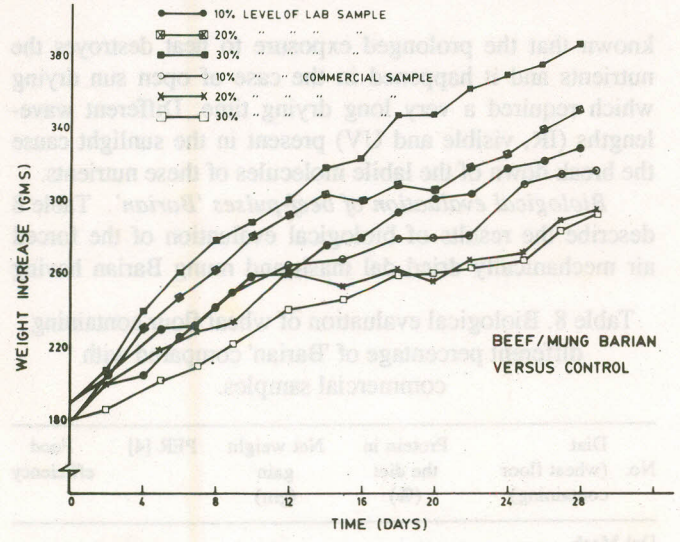

Fig. 2. Growth curves of rats using beef-mung barian against the market samples used as control.

25% beef. Net weight gain, protein efficiency ratio (PER) and feed efficiency using the diet containing 10, 20 and 30% level of dal-beef "Barian' in wheat flour, were measured [4]. In case of control, the comparison was made with similar levels of market sample in wheat flour. Weight gain measurements were made on alternate days which have been shown graphically in Fig. 1 and 2. There appears to be a clear cut positive edge of the laboratory samples over the market products of similar type in respect of biological evaluation.

The percentage of protein in the diets made using different levels of 'Barian' is shown in Table 8. It is interesting to note that at any one level of laboratory made beef 'Barian', the percentage of protein in the diet was not more than in the diet made with commercial 'Barian' samples. However, net weight gain of rats which occured during 28 days of the experiments, the PER and feed efficiency, were constantly superior in the case of the former samples. Leaving aside other factors it leads to conclude that the high quality animal protein (beef) used in the laboratory made samples was mainly responsible for the superior growth rates.

Acknowledgement. The research work carried out was made possible by the funding of the International Development Research Centre (IDRC) of Canada under their Project No. 3-P-84-0024, meat processing (Pakistan).

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