Technology Section

Pak. j. sci. ind. res., vol. 34, no. 5, May 1991

FATTY ACID PROFILE OF HYDROGENATED OILS USED IN PAKISTAN

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(Received August 10, 1989; revised June 17, 1991)

Fatty acid composition of the hydrogenated vegetables oils produced in Pakistan over the last three decades has been determined and compared. The vanaspati of today has been found to be more balanced with regard to essential fatty acids than the product of yester years.

Key words: Fatty acid, Hydrogenated oils.

Introduction

Hydrogenation is the single most widely used modification process for fats and oils worldwide [1]. In Pakistan and India the process is carried out more extensively because the product of the reaction is consumed as the main dietary fat. Although the process has been in vogue since 1903 [2], it was only in 1970's that aspertions were cast on the metabolism of hydrogenated vegetable oils ('vanaspati' as they are locally called) owing to the presence of trans fatty acids in them. According to the latest reviews [3-4] on the subject the trans acids are readily metabolised and are incorporated into the body fat. However, as these trans acids are produced during hydrogenation at the expense of essential fatty acids, any adverse effects on health and metabolism can be ascribed to the imbalance between the intake of trans and essential fatty acids. These acids pose no health problems at the levels at which they are currently consumed by most populations around the world. The only exception to this would be Pakistan and India where vanaspati is the main dietary fat without a high level of essential fatty acids.

The present study was undertaken with a view to investigating the composition of the hydrogenated fats used in Pakistani diets. This is important if the metabolism of this fat is to be understood. Also it is highly desirable to assess the extent of availability of essential polyunsaturated acids. For this purpose the full range of hydrogenated fat manufactured in Pakistan by most of the vanaspati producing units was subjected to the compositional analysis.

The oil blends that are used for hydrogenation have been undergoing a complete change during the last 25 years or so, for want of one component of the blend or the other. Consequently a complete spectrum of the essential fatty acids consumed by the people during this period must be available to facilitate any nutritional study on the vanaspati. The present paper presents a comprehensive comparison of the vanaspatis available to the people over the last 25-30 years.

Experimental

The ghee samples analysed were obtained from the production units directly and so the element of risk with regard to contamination and adulteration in the market was eliminated.

A.R. grade chemicals, methanol, benzene, ether, sodium sulphate (E. Merk) acetyl chloride and sodium chloride (BDH) were used.

Preparation of methyl esters [6]. Methyl esters of the fatty acids of ghee (vanaspati) glycerides were prepared by the method of Kumar and Tsunoda as given below.

A mixture (40-50 ml) of methanol, acetyl chloride, benzene was added to the sample (0.5 g) and refluxed for one hr. The reaction mixture was extracted with 25 ml of diethyl ether. The ethereal layer was washed with a saturated solution of sodium chloride, and then dehydrated over anhydrous sodium sulphate and filtered. The ether from the filtrate was evaporated under reduced pressure and methyl esters were obtained.

Gas liquid chromatography of methyl esters. The methyl esters were chromatographed on a Pye-Unicam 204 series chromatograph containing an FID detector. A glass column (1.5 m long and internal diameter of 4 mm) was used. The stationary phase was 10% polyethylene glycol succinate (PEGS) coated on diatomite (80-100 mesh) support. Both the materials were of Pye-Unicam origin. Nitrogen was used as carrier gas. Other conditions of chromatographic runs were as under:

Injection temperature:	220°
Column temperature:	220°
Detector temperature:	250°
Rate of flow of nitrogen	40 ml/min.

Fatty acid percentages were computed from the peak areas corresponding to respective acids and are given in Table 2 and 3.

TABLE 1. FATTY ACID COMPOSITION OF THE TOTAL FATTY ACIDS IN VANASPATIS AVAILABLE IN PAKISTAN IN THE 1960's (AVERAGE OF 9 BRANDS)

Saturated acids					Monounsaturated acids		Polyunsaturated acids	
$C_{12:0}$	$C_{14:0}$	$C_{16:0}$	$C_{18:0}$	$C_{20:0}$	$C_{16:1}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$
T	T	13.5	9.2	-	–	77.0	T	–

TABLE 2. FATTY ACID COMPOSITION OF THE VANASPATIS MANUFACTURED IN PAKISTAN IN THE PERIOD 1970-80.

S.No.	Name of the unit	Brand name	No. of samples analysed	Saturated Acids					Monounsaturated acids		Polyunsaturated acids	
				$C_{12:0}$	$C_{14:0}$	$C_{16:0}$	$C_{18:0}$	$C_{20:0}$	$C_{16:1}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$
1.	Punjab Vegetable Ghee Mills, Lahore	Star	4	T	2.10	35.20	4.92	0.70	–	42.00	14.35	0.72
2.	Universal Oil Mills, Sheikhupura	Rachna	3	0.61	1.92	32.42	5.82	0.85	–	41.52	15.94	0.92
3.	Suraj Ghee Inds Sheikhupura	Salva	4	0.92	2.20	30.41	5.93	0.64	–	45.25	13.80	0.84
4.	Khyber Vegetable Ghee Mills, Lahore	Khyber Golden	3	0.68	1.89	29.26	5.34	0.90	–	40.84	19.98	1.10
5.	Kohinoor Oil Mills Sheikhupura	Kohinoor	3	–	1.13	37.80	4.90	–	–	42.46	13.70	–
6.	Fazal Ghee Mills Islamabad	Motigheel	2	–	1.34	42.85	4.29	–	–	36.26	15.26	T
7.	United Industries Faisalabad	Kashmir	3	–	1.29	24.18	6.05	–	–	52.92	15.55	–
8.	Sargroh Ghee Mills, Faisalabad	Chand	2	0.25	1.62	34.2	5.3	–	–	41.20	17.42	–
9.	Morafco Industries Faisalabad	Shalimar	3	0.38	1.14	30.72	4.05	–	–	36.35	26.42	0.93
10.	Kakakhel Industries Faisalabad	Shahtaj	2	0.28	1.20	28.40	5.86	–	–	40.75	23.50	T
11.	Sh. Fazal-ur-Rehman & Sons, Multan	Rose	3	0.18	1.90	31.68	5.60	0.82	–	46.42	12.36	1.03
12.	A&B Industrial Gases Multan	Mehran	2	–	1.80	34.26	4.83	0.74	–	36.76	21.6	–
13.	Crescent Factories, (New) Chichawatni	Khyber	2	0.30	1.59	26.21	5.37	0.64	–	45.53	19.65	0.70
14.	Associated Industries Nowshehra	Shama	3	0.33	1.96	24.32	6.80	0.42	–	52.76	13.40	T
15.	Bara Ghee Mills, Bara	Bara	2	T	2.20	31.46	5.65	0.87	–	43.20	15.75	0.86
16.	Dargai Ghee Mills, Dargai	Sarhad	2	0.52	1.88	22.62	6.65	–	–	50.96	16.46	0.90
17.	Haripur Ghee Project Haripur	Yakta	3	0.78	2.00	24.50	6.92	0.80	–	48.71	15.48	0.78
18.	A&B Industries, Karachi	Hilal	3	0.94	1.84	30.24	7.40	0.87	–	44.17	14.52	–
19.	Bengal Ghee Mills Karachi	Bakery	3	–	2.60	24.82	8.67	1.58	–	42.74	11.64	7.94
20.	Hydari Industries, Hyderabad	Talwar	4	0.42	1.40	29.52	9.25	0.92	–	45.39	12.65	0.44
21.	Wazir Ali Industries, Hyderabad	Tullo	4	–	1.95	34.62	11.72	–		41.10	10.60	–
22.	Burma Oil Mills, Karachi	Bahar	3	–	1.89	22.64	13.20	–	-	62.26	–	–
23.	E. M. Oil Mills Karachi	Malta	4	-	0.68	22.88	–	–	–	49.76	26.66	–
24.	Asaf Industries, Shikarpur	Mehran	3	0.92	1.86	30.42	6.98	0.82	–	41.70	16.47	0.82
25.	Chiltan Ghee Mills, Quetta	Chiltan	2	–	0.82	29.98	5.18	–	–	49.52	14.49	–
26.	Maqbool & Co, Karachi	Eagle	2	0.84	2.11	32.52	5.20	0.96	–	42.20	15.37	0.79

TABLE 3. FATTY ACID COMPOSITION OF THE VANASPATIS MANUFACTURED IN PAKISTAN IN THE PERIOD 1986-89.

S.No.	Name of the unit	Brand name	No. of samples analysed	Saturated acids						Monounsaturated		Polyunsaturated	
				$C_{10:0}$	$C_{12:0}$	$C_{14:0}$	$C_{16:0}$	$C_{18:0}$	$C_{20:0}$	$C_{16:1}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$
1.	Suraj Ghee Mills, Sheikhupura	Salva	3	0.90	0.12	1.08	30.29	7.10	0.95	–	25.55	30.74	3.26
2.	United Industries, Faisalabad	Kashmir	3	2.97	0.17	0.79	31.52	9.45	–	–	25.02	29.12	0.86
3.	Sargroh Ghee Mills, Faisalabad	Chand	2	–	0.25	1.62	34.2	6.30	–	–	30.20	27.42	–
4.	Sh. Fazalur-Rehman Multan	Rose	2	1.52	T	0.90	35.26	7.90	1.71	–	25.42	24.70	2.58
5.	A&B Industrial Gases Multan	Mehran	2	–	–	1.82	34.26	4.90	0.74	–	36.76	21.50	–
6.	Crescent Factories (New) Chichawatni	Khyber	2	–	0.30	1.59	30.20	5.37	0.64	–	32.52	28.65	0.72
7.	Associated Industries Nowshehra	Shama	3	2.15	0.15	0.86	32.85	8.20	1.10	–	25.27	27.64	1.76
8.	Bara Ghee Mills, Bara	Bara	2	2.35	T	0.99	30.57	8.20	1.04	–	27.42	26.46	2.95
9.	Chiltan Ghee Mills Quetta	Chiltan	2	1.20	0.15	0.76	31.42	9.37	–	–	25.86	28.10	3.13
10.	Asaf Industries, Shikarpur	Mehran	2	–	T	2.20	30.46	5.65	0.86	–	27.20	32.75	0.86
11.	Wazir Ali Industries Hyderabad	Tullo	3	–	0.52	1.88	24.62	6.66	–	–	32.95	32.46	0.90
12.	E. M. Oil Mills, Karachi	Malta	3	–	0.32	1.96	24.32	6.80	0.42	–	37.75	28.42	T
13.	A&B Industries, Karachi	Hilal	2	–	0.18	1.92	30.67	5.60	0.82	–	28.42	31.35	1.03

Discussion

A comparison of the Tables 1, 2 and 3 clearly shows that the profile of the essential fatty acids available to the general consumer in Pakistan has undergone a complete change over the past three decades. Thus the linoleic acid content of the vanaspatis marketed in the 1960's was negligible (Table 1) and this was a serious neglect on the part of the manufacturers, since linoleic acid (18 : 2) is an essential fatty acid (EFA) of utmost importance and is required for the normal growth and function of all tissues. The trend with respect to the EFA's improved in the next twenty years at the expense of $C_{18:0}$ and $C_{18:1}$ acids.

It may appear surprising from Table 1 that Mirza and Underwood [5] took an average of 9 samples only and that too from limited areas to represent the overall picture of the country at that time from the point of view of vanaspati production. This probably could be due to the following reasons.

i. Fewer hydrogenation units were operative at that time.

ii. This was the period when the desi ghee (butter fat) was being consumed in the country quite competitively and the manufacturers of the day wanted their product to look like the natural product. So to bring about the desired grannulation in the finished product the oils were submitted to extensive hydrogenation.

The situation with respect to desi ghee (butter fat) deteriorated during 1970's as the cattle farming and dairy industry could not keep pace with the phenomenal rise in population. The hydrogenation units mushroomed through the length and breadth of the country and the manufacturer enjoyed more autonomy in the choice of oil blends for submission to hydrogenation. Table 1 supports this observation as here the profile or the fatty acids is more variable, however, the EFA's have not been given any importance.

The fatty acid profile in the last about three years has changed significantly (Table 3) as the products of various units producing vanaspatis are more or less uniform. This probably is due to the fact that the blend now available for hydrogenation is centrally controlled. That is why the samples analysed and reported here have been taken from mills that represent all the regions of the country, other mills belonging to the same regions also had almost similar analytical data and have been omitted for this reason.

Tables 2 and 3 manifest an appreciably higher content of $C_{16:0}$ acid which is an indication of palm oil advent in the field. This oil is now being extensively incorporated in the vanaspatis (either before or after the hydrogenation stage). However,

the level of linoleic acid in the current products is quite high and these hydrogenated products are more balanced than the ones ever produced before in the country.

The basic nutritional health and safety concerns for edible fats and oils have completely changed in the past thirty years or so and probably will continue changing in future too or as long as population growth and oilseed production have not attained an equilibrium. Even then there will always be concern to develop and manufacture products with good functional characteristics for practical utilisation.

The trans acid polemic will probably never go away as biochemical evaluations will always be looking for absolute proofs which are hard to come. In fact the subject will attain more importance as the advancements in analytical techniques continue to improve. In the meantime, however, it is satisfactory to observe, as a result of the present study, that the hydrogenated product of the eightees is better than that of the sixtees.

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