



## Milk fatty acid profile of Indian dairy cows reared under organic and conventional feeding management

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Organic livestock production towards organic agriculture, is slowly gaining momentum in India, because of increasing consumers awareness and the increasing demand for organic milk and meat.

Composition and quality are important characteristics that determine milk nutritive value and consumer acceptability. Milk fat contains approximately 400 different fatty acids. Normally milk fat contains about 65% saturated, 30% monosaturated and 5% polyunsaturated fatty acids. Poly unsaturated fatty acids such as omega 3 and omega 6 and mono unsaturated fatty acids are considered to be good for human health. The higher contents of saturated fatty acids are known to have been associated with variety of diseases. There are several other studies (Siri-Tarino 2010, Chowdhury 2014, Rajorhia 2018) which opined that saturated fat is not associated with risk of cardiovascular diseases. It is reported by Rajorhia (2018) that abundant presence of saturated fatty acids reduces the incidence of type-2 diabetes in human beings.

In the country like India, cows are regarded as holy cow and are worshiped and their milk is preferred over the other species. Cows contribute more than 45% of the countries milk production. Sahiwal, Tharparkar and Gir are important milk cattle breeds of India ([www.biodiversityofindia.org/index.php?title=Native cow varieties of India](http://www.biodiversityofindia.org/index.php?title=Native_cow_varieties_of_India)). Information on compositional differences of cow's milk fatty acids between organic and inorganic system of rearing is scanty. Hence, the objective of the present work was to compare the milk fatty acid profile of these breeds under organic and conventional feeding and management system.

Studies on organic milk production was conducted in the central research farm at ICAR-Indian Grassland and Fodder Research Institute (ICAR-IGFRI), Jhansi, which is situated at an with average elevation of 284 m on central plateau of India. Studies were conducted on famous

indigenous cattle breeds of India namely, Sahiwal, Tharparkar and Gir. For organic management, cows were kept strictly under organic feeding and management following NPOP (National Program for Organic Production) standard of organic management. Space per animal was above the Indian standard-IS: 12237–1987 (Loose housing, 3.5–4 m<sup>2</sup> as covered area and 7–8 m<sup>2</sup> as open area). Vaccination and de-worming allowed as per National Program for Organic Production Standards (NPOP) ([www.apeda.gov.in/apedawebsite/organic/ORGANIC\\_CONTENTS/National Programme for Organic Production.htm](http://www.apeda.gov.in/apedawebsite/organic/ORGANIC_CONTENTS/National_Programme_for_Organic_Production.htm)). Required treatment of illness managed through Ayurvedic or organic means of naturopathy. Drinking water was free from any pesticide or chemical residues. Feeds and fodder were grown in field which were converted to organic field following organic protocols and process by 30 months like use of residue free water for irrigation, using organic fertilization like green mulch, vermi-compost and farm yard manure following requirement of NPK for particular fodder types. Feeds produced like oat, barley, maize and mustard were grown organically and used to prepare organic feeds. The NPOP organic standards followed in the feed fodder and livestock production were certified by the authorised organic standard certifying agency “SGC India Pvt. Ltd.” vide certificate number IN11350 and ORG/SC/1110/002403.

Cows maintained under inorganic groups were maintained under conventional feeding and management with fodder grown under conventional inorganic fertilization and process. Milk thus produced from above two systems was analyzed for its quality and fatty acid profile. Milk samples for fatty acid profile were collected from 24 lactating cows with 4 cows of each of 3 breeds in organic and inorganic systems during the month of January. Average days of lactation at the time of sampling were 90 days ranging from 25 to 120 days. Animals were milked manually at morning and evening, in a day. Individual milk samples (1000 ml) were collected in morning. Fat was separated from each of the milk samples collected. Milk fat samples (50 ml) were sent for analysis for milk fatty acid profile at CSIR-Central Food Technological Research

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Institute, Mysore (CSIR-CFTRI), India, using AOCs Official Method 1998, Ce 1–62 and Ce 2–66. Data were analysed in SPSS. The two-way ANOVA and Tukey's HSD post-hoc test ( $P < 0.05$ ) were used for the evaluation of differences in concentrations of fatty acids between the breeds and between the rearing system.

Fat content differed significantly among the breeds, however it was similar between organic and conventional feeding systems (Table 1). A total of twenty three fatty acids of different saturation levels were detected in cow's milk, in which 14 were saturated (SFA), 8 were unsaturated fatty acids (USFA) and 1 was unidentified fatty acid. Milk fatty acid profile of different breeds and feeding systems (organic vs inorganic) is presented in Figs. 1 and 2. Milk from Sahiwal Gir and Tharparkar cows contained 64.52%, 65.51% and 66.06% saturated fatty acids (SFA), 25.62%, 25.37% and 24.19% mono-saturated fatty acids (MUFA), and 2.28%, 2.31% and 2.27% poly-unsaturated fatty acids (PUFA), respectively. Fatty acid composition among the breeds was comparable (Table 1), while Pentadecanoic acid (C15:0) in Sahiwal, Gir and Tharparkar milk (1.50, 1.57 and 1.76%) was higher than normally found (1.2%) in cow's milk fat.

Milk fat from organic and inorganic system contained 63.88% and 66.84% saturated fatty acids (SFA), 26.49%

and 23.64% monounsaturated fatty acids (MUFA), and 2.42% and 2.16% polyunsaturated fatty acids (PUFA), respectively (Fig. 2). The major SFA were palmitic acid (C16:0), myristic acid (C14:0) and stearic acid (C18:0). The major MUFA were oleic acid (C18:1) and palmitoleic acid (C16:1) and the major PUFA was linoleic acid (C18:2, omega-3). The predominant fatty acids were palmitic acid (C16:0), oleic acid (18:1), stearic acid (C18:0) and myristic acid (C14:1), where they formed 66.45% and 65.15 of total fatty acids in milk fat from organic and inorganic system, respectively (Table 1). The omega 3 and omega 6 (N-3/ N-6) ratio was 0.63 and 0.61 for cow milk fat from organic and inorganic system, respectively (Fig. 3).

The differences in fatty acids between organic and conventional feeding systems were similar. However, in general, saturated fatty acids were comparatively higher in in-organic system and unsaturated fatty acids (including essential fatty acids, omega 3 and omega 6) were comparatively higher in cows maintained under organic feeding system. These observations were substantiated by Akbari *et al.* (2011) who reported that the application of bio-fertilizer in sunflower crop, resulted in a significant decrease in the saturated fatty acids and increase in unsaturated fatty acids in sunflower oil, in comparison to untreated crop. As the PUFA are not synthesized by

Table 1. Milk fat fatty acid composition (% by weight) on three breeds and two systems of rearing

Parameter	Type	Breed			System		Total	SEM	P values	
		Sahiwal	Gir	Tahrparkar	Organic	Conventional			B	S
Fat (%)		4.09	3.74	4.57	4.16	4.11	4.13	0.094	0.001	0.794
<i>Fatty acids (%)</i>										
Butyric acid (C4:0)	SFA	3.51	3.87	3.52	3.34	3.93	3.63	0.17	0.626	0.099
Caproic acid (C6:0)	SFA	3.02	3.35	3.15	3.00	3.34	3.17	0.14	0.658	0.263
Caprylic acid (C8:0)	SFA	1.62	1.85	1.96	1.68	1.94	1.81	0.08	0.216	0.109
Capric (C10:0)	SFA	2.81	3.18	3.08	2.90	3.15	3.02	0.16	0.662	0.463
Undecanoic acid (C11:0)	SFA	0.40	0.52	0.46	0.45	0.47	0.46	0.03	0.272	0.687
Lauric acid (C12:0)	SFA	2.78	3.10	3.13	2.90	3.11	3.00	0.13	0.533	0.440
Myristic acid (C14:0)	SFA	10.18	10.52	10.88	10.05	11.00	10.53	0.35	0.739	0.208
Myristoleic acid (C14:1)	MUFA	1.45	1.68	1.55	1.52	1.60	1.56	0.10	0.664	0.728
pentadecanoic acid (C15:0)	SFA	1.50	1.57	1.76	1.65	1.56	1.61	0.05	0.092	0.346
Pentadecenoic acid (C15:1)	MUFA	0.53	0.48	0.58	0.58	0.49	0.53	0.03	0.453	0.165
Palmitic acid (C16:0)	SFA	25.95	25.96	25.81	25.20	26.62	25.91	0.053	0.992	0.214
Palmitoleic acid (C16:1)	MUFA	2.26	2.21	2.43	2.25	2.35	2.30	0.10	0.690	0.684
Heptadecanoic acid (C17:0)	SFA	0.87	0.86	1.02	0.93	0.90	0.92	0.04	0.252	0.774
Heptadecenoic acid (C17:1)	MUFA	0.53	0.52	0.52	0.55	0.50	0.52	0.02	0.968	0.380
Stearic acid (C18:0)	SFA	10.41	9.18	9.81	10.22	9.38	9.80	0.46	0.581	0.385
Oleic acid (C18:1)	MUFA	20.22	19.92	18.50	20.98	18.11	19.55	0.75	0.594	0.063
Linoleic acid (omega 6) (C18:2)	PUFA	1.38	1.43	1.41	1.48	1.34	1.41	0.04	0.913	0.154
Linolenic acid (omega 3) (C18:3)	PUFA	0.90	0.88	0.86	0.94	0.82	0.88	0.04	0.932	0.175
Arachidic acid (C20:0)	SFA	0.46	0.42	0.43	0.47	0.40	0.44	0.03	0.923	0.401
Eicosanoic acid (C20:0)	SFA	0.53	0.65	0.57	0.63	0.54	0.58	0.05	0.727	0.440
Behenic acid (C22:0)	SFA	0.48	0.48	0.48	0.46	0.50	0.48	0.05	1.000	0.736
Erucic acid (C22:1)	MUFA	0.63	0.56	0.61	0.61	0.59	0.60	0.05	0.884	0.844
Unidentified		7.48	6.78	7.39	7.13	7.30	7.21	0.31	0.640	0.791

SFA, Short chain fatty acids; MUFA, Mono unsaturated fatty acids; PUFA, Poly unsaturated fatty acid.

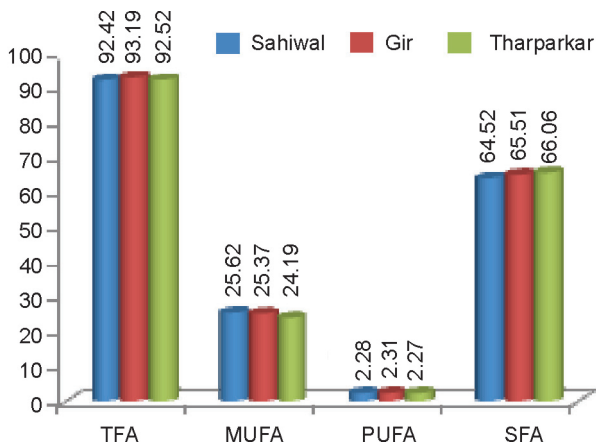


Fig. 1. Content of major groups of fatty acids (%) in different breeds of cattle.

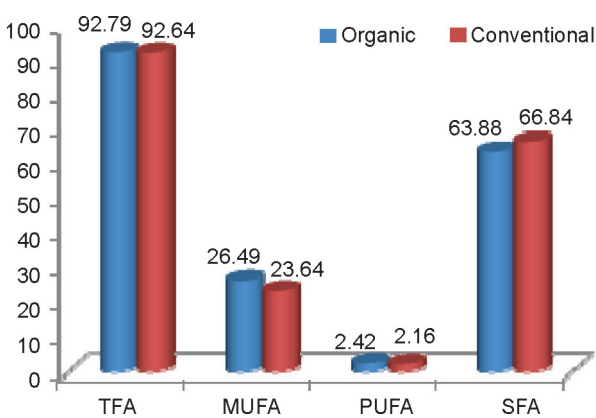


Fig. 2. Content of major groups of fatty acids (%) in organic and conventional feeding system.

ruminant tissues, therefore their concentration in milk depends firstly on the PUFA content of the diet and secondly other amount of PUFA which escapes ruminal bio hydrogenation (Chilliard *et al.* 2001). It has been observed that application of manure significantly increased the chlorophyll content in maize (Zafar *et al.* 2011) leading to higher intake of linoleic and linolenic fatty acid (Elgersma *et al.* 2005) resulting in higher content of MUFA and PUFA in the cow's milk fed organically grown fodder as compared to inorganically grown fodder.

From the results of present study, it may be concluded

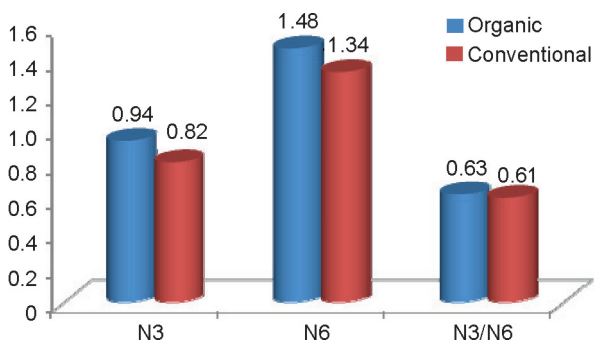


Fig. 3. Omega fatty acids (%) and their ratio in organic and conventional feeding system.

that, though the differences between organic and inorganic milk fatty acids were not significant, but the fatty acids which are considered to be good for human health (i.e. unsaturated fatty acids, MUFA, PUFA, omega 3 and omega 6 etc.) were comparatively higher in organic milk fat. The present study was based on small number of samples, an extensive study with sufficiently large number of samples is required to explore the potential of organic milk to be utilized by the today's health conscious society.

SUMMARY

In this study, milk fat content and milk fatty acid profile of 3 Indian dairy cattle breeds, viz. Sahiwal, Tharparkar and Gir was studied under organic and conventional feeding system. Milk fat content differed significantly among the breeds and varied from 3.74 to 4.57% across the breeds, however the feeding system did not influence the milk fat contents. Fatty acids contents were similar among breeds and feeding systems, however, the unsaturated fatty acids were comparatively higher in organic feeding system.

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