

Survey of per capita consumption of vegetable oil in India

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To analyse the domestic consumption pattern of vegetable oils, ICAR-Indian Institute of Oilseeds Research, Hyderabad, undertook an online survey through Google forms. The survey aimed at generating estimates of average household monthly per capita consumption of vegetable oils, distribution based on urban or rural households, average consumption by income groups, most preferred type of oil and brand by consumers, crop-wise percentage of consumers, food habits and consumption of the same oil or multiple oils throughout the year. Results indicated that rural households consumed 15.6 kg of oil per person per annum, whereas urban households consumed 12.4 kg. Non-vegetarians (64%) consumed 14.2 kg of oil per person per annum, whereas vegetarians (36%) consumed 12.6 kg. Mustard oil was most preferred in the north (61%) and east (35%) zones of India, followed by sunflower oil. About 28% of people in the west zone consumed soybean oil, followed by mustard oil (25%) and sunflower (25%) oil. Sunflower oil (44%) was the most popular oil in the southern zone, followed by groundnut oil (29%). Total per capita consumption of oil, including other purposes, was 14.43 kg per annum.

Keywords: Annual oilseeds, consumption pattern, rural and urban households, survey, vegetable oil.

OILSEED crops are the second most important commodity contributing significantly to the agricultural economy. During the 1990s, self-sufficiency in oilseeds was attained through the yellow revolution with the establishment of technology mission on oilseeds in 1986. The world area of oilseeds increased from 197 m ha in 2010 to 230 m ha in 2019, with a total production of 521 mt (Table 1). The world average yield ranged from 2071 to 2264 kg/ha. India occupied 24.79 m ha with a production of 31.52 mt (2018–19). In spite of being the fifth largest oilseed crop-producing country in the world with a compound annual growth rate of production of 2.77% from 2000 to 2019, India could not keep pace with the per capita consumption of edible oils. Due to the increase in population and enhanced income, the per capita consumption of edible oil increased from 2.9 kg/annum in 1950–60 to 17.07 kg/annum in 2010–20 (Table 2). To meet this ever-increasing demand, India is importing 60% of its requirements, i.e. 13.42 mt worth Rs 73,813 crores, with the total requirement of edible oil at 24.07 mt (2020–21) (Figure 1). Oilseed crops such as soybean,

groundnut and mustard together contribute more than 80% of the primary sources of vegetable oil. In addition, 3 mt of vegetable oil is obtained from secondary sources such as cotton seed, rice bran, palm and coconut. The sources of domestic oil production for the quinquennial 2015–16 to 2019–20 were annual oilseeds at 67.4%, cotton seed at 11%, rice bran at 9.8%, coconut at 5.1%, palm at 2.2%, and the remaining from the Solvent Extractors Association of India, and tree and forest origin (Figure 2). Vegetable oils are also used to make soaps, skin care and cosmetic products, candles, perfumes, paints and insulators in the electrical industry.

The Food and Agriculture Organization of the United Nations has reported that global edible vegetable oil allocated to food use increased by about 48% from 1995 to 2019 (ref. 1). Data Bridge Market Research analysis indicated that the global edible oil market will project a compound annual growth rate (CAGR) of 7.1% for the forecast

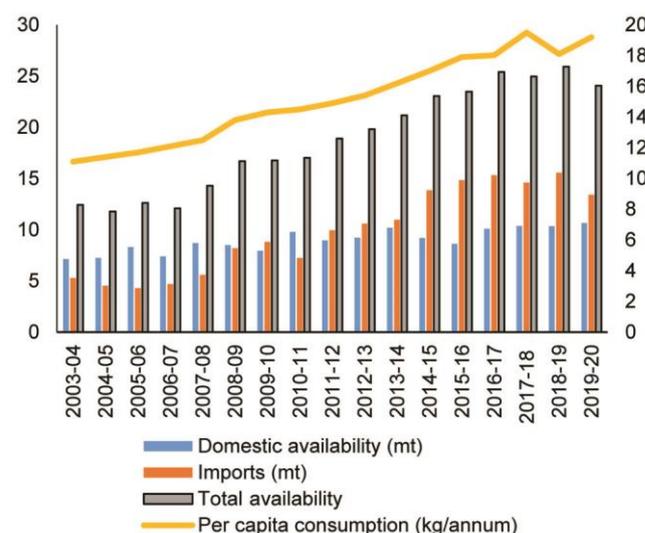


Figure 1. Import and per capita consumption of edible oils (quinquennial 2015–16 to 2019–20).

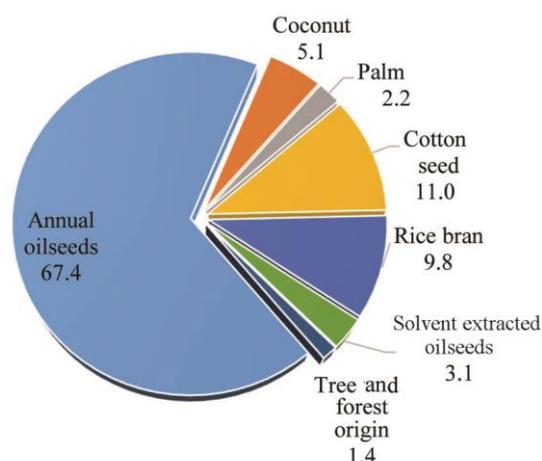


Figure 2. Domestic oil production from different sources.

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Table 1. Oilseeds scenario in the world and India

Year	World			India		
	Area (m ha)	Production (mt)	Yield (kg/ha)	Area (m ha)	Production (mt)	Yield (kg/ha)
2010	197.49	409.10	2071	25.96	24.88	958
2011	202.59	416.51	2056	27.22	32.48	1193
2012	205.00	394.01	1922	26.31	29.8	1133
2013	216.34	453.88	2098	26.48	30.94	1168
2014	223.74	481.09	2150	28.05	32.75	1168
2015	223.67	494.47	2211	25.60	27.51	1075
2016	226.53	509.10	2247	26.09	25.25	968
2017	234.52	544.19	2320	26.18	31.28	1195
2018	235.22	534.54	2273	24.51	31.46	1284
2019	230.21	521.28	2264	24.79	31.52	1271

Source: <http://faostat3.fao.org>; Directorate of economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India.

Note: Annual oilseeds includes castor, groundnut, linseed, rapeseed and mustard, safflower, sesame, soybean and sunflower.

Table 2. Population and per capita oil consumption

Year	1950–60	1960–70	1970–80	1980–90	1990–2000	2000–2010	2010–2020
Population (million)	361.1	439.2	683.3	846.4	1028.7	1210.9	1320.0
Average per capita consumption (kg/annum)	2.90	3.10	3.34	5.26	8.03	12.42	17.07

period 2021–28 (ref. 2). Domestic vegetable oil production includes annual oilseeds (67.4%), coconut (5.1%), palm (2.2%), cottonseed (11.0%), rice bran (9.8%), solvent extraction of oilseeds (3.1%) and tree and forest origin (1.4%) (ref. 3). Production technology advances have increased supply through yield improvement and productive land expansion. Shifts in competing oil uses have contributed to changes in the availability and relative price of different oil products, while more discriminating consumer preferences and regulations have altered supply and demand. The National Sample Survey Office (NSSO), Government of India, conducts nationwide household consumer expenditure surveys at regular intervals as part of its ‘rounds’, with each round normally of one year duration. These surveys are conducted through interviews of a representative sample of households selected randomly through a scientific design and cover almost the entire geographical area of the country. Arya *et al.*⁴ surveyed the market trends and brand preferences of edible oil using questionnaires among 200 respondents from Hisar district, Haryana. It was found that soybean oil was consumed by 45% and sunflower oil by 15% of the villagers. Narayanaswamy and Ramasamy⁵ analysed the trend in edible oil use and assessed consumer behaviour on the use of edible oil from various income groups in Chennai, Tamil Nadu. About 1000 samples were surveyed from all five zones of Tamil Nadu⁶. The results revealed that the dominant edible oil consumed was sunflower oil in both the rural and urban regions of the state. Groundnut oil, which was traditionally consumed by households, has now been replaced by sunflower oil, implying the need for appropriate changes in production. Edible oil and fat consumption patterns among 300 Turkish consumers in Manisa were studied

by Özbek⁷. Olive oil and sunflower oil were reported to be consumed daily, while hazelnut oil and corn oil were not preferred. Özbek⁷ emphasized that ‘brand’ was the primary influencer for purchasing edible oil among 30% of Turkish consumers. On the other hand, the most important criterion in the oil consumption of the respondents was flavour (41%). Likewise, 150 consumers in Faisalabad, Pakistan, were surveyed for factors affecting the consumption of edible oil⁸. Results from the primary data suggested that price, income and family size significantly affected the consumption of ghee and oil⁸. The survey also collected information on using vegetable oil for other purposes.

All the previous surveys were carried out with a small sample size and specific to a particular location. While considering the limitations of previous surveys and the factors defining consumption, ICAR-Indian Institute of Oilseeds Research (IIOR), Hyderabad, undertook an on-line survey to analyse the domestic consumption pattern of vegetable oils. The survey aimed at generating estimates of average monthly per capita consumption of households, distribution of households in urban or rural areas, the break-up of average consumption by income groups, the most preferred type of oil and brand by the consumers, crop-wise percentage of consumers based on food habits and percentage of consumers using the same oil or multiple oils throughout the year. The distribution of consumers highlights differences in the standard of living of different population segments and is an effective tool for studying the consumption pattern of edible oil.

Key indicators used in this study represent the most important measures of the standard of living of the relevant domains of the population. Google forms were generated

in nine languages (Hindi, English, Telugu, Marathi, Tamil, Kannada, Gujarati, Odia and Bengali) under the mail id oilconsumption@gmail.com and circulated throughout India with the help of the Agricultural Universities, Krishi Vigyan Kendras (KVKs), Indian Council of Agricultural Research (ICAR) institutions, schools, colleges and hospitals to all rural and urban families for collecting data on-line regarding household oil consumption pattern. The Google forms contained 18 questions (Annexure 1). The language-wise responses were collected and downloaded as an Excel sheet for further analysis. Microsoft Excel was used to analyse consumption percentage by zone, state, area, food type, preferred oil and brand.

A digital survey method was followed to reach a large number of respondents across various states in different languages. The survey was conducted with the support of All India Coordinated Research Projects (AICRPs) and KVKs to cover different states, villages, and both urban and rural households. The Google forms were generated considering various aspects influencing consumption, viz. income group, food habits and urban/rural households. Figure 3 depicts the different parameters affecting the per capita consumption of edible oil. The physical survey of households needs to engage people to fill out the questionnaire, while the digital survey helps save time and money. Also, the survey could be done successfully despite the prevailing COVID-19 pandemic.

Out of the 22,100 responses (total people about 1.0 lakh) representing all the states, 12,155 were from rural areas and 9945 from urban areas. The rural population consumed 15.6 kg of oil per head per annum, whereas the urban people consumed 12.4 kg. About 39% of respondents had a

family size of 4, 19% had 3 members and the remaining had a family size of 1, 2 or more than 4. With regard to food habits, non-vegetarians (64%) consumed 14.2 kg of oil per person per annum, while vegetarians (36%) consumed 12.6 kg per person per annum. With regard to preferences of the respondents, 70% used the same type of oil throughout the year, while 30% used different oils. Around 50% of the respondents belonged to the lower income group (1–5 lakhs) with a per capita oil consumption of 16.5 kg per annum; 28% were in the 5–10 lakhs income group consuming 12.6 kg per annum and 22% were in the above 10 lakhs income group consuming 11.4 kg per annum. It is considered that with increasing income, per capita consumption of oil also increases; but it has been observed that the consumption in higher-income groups is less than that of the low income groups. With regard to the type of oil, 74% of respondents used branded oil, 19.2% ghani oil, 13% loose oil and only 4% used virgin or extra virgin oil (Figure 4 a). (The percentage exceeds 100 due to the consumption of more than one type of oil by the respondents.) Figure 4 b shows the predominantly preferred brands.

The zone-wise consumption pattern depicted in Figure 5 shows that consumption is high in the west, followed by the east, south, central and north zone. Figure 6 indicates the different types of oil used by the consumers. About 61.1% of the North Indian region (Delhi, Punjab, Jammu and Kashmir, Himachal Pradesh and Uttar Pradesh) consumed mustard oil, followed by sunflower (12%), rice bran (9%), olive oil (7%) and others (11%) (Figure 6 a). Among the southern states (Telangana, Andhra Pradesh, Tamil Nadu, Karnataka, Kerala and Goa), 44% consumed sunflower oil, followed by groundnut (29%), rice bran (7%), palm oil (9%) and others (14%) (Figure 6 b). Soybean (28%) was the major oil consumed in the western zone (Gujarat, Maharashtra, Rajasthan and Madhya Pradesh), followed by mustard and sunflower (25%) (Figure 6 c). Like in North India, most of the respondents in the eastern zone consumed mustard oil (29%), followed by sunflower oil (19%) (Figure 6 d). Most respondents indicated using all major edible oils, while only a negligible percentage consumed palm oil and none consumed cotton seed oil. Oil consumption varied from <6 kg/person/annum to >20 kg/person/annum (Figure 7). The average per capita consumption for 2021 was 18.76 kg per annum. The average per capita oil consumption, including out-of-home consumption, was 1.16 kg per month, accounting for a total of 13.93 kg per annum. The oil used for other purposes (pooja/hair oil/massage, etc.) was around 0.5 kg per head per year. Ghee and butter consumption (animal sources) was around 1.4 kg per head per year. Thus, the total per capita consumption of oil, including for other purposes, was 14.43 kg per annum. The remaining edible oil (4.33 kg) was used for making soaps, pharmaceutical industry, etc. India is famous for its kachi ghani oil or expelled oil in local ghanis. Interestingly, the use of refined processed oil and kachi ghani oil was almost the same in both urban and rural households.

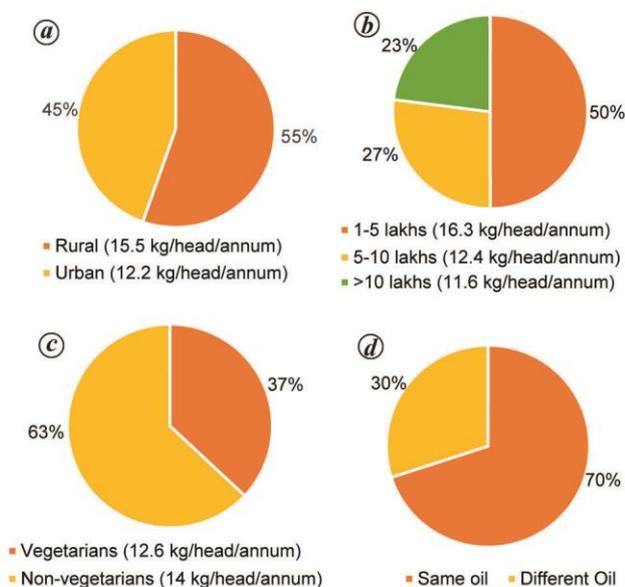


Figure 3. Oil consumption based on different parameters. *a*, Region-wise response. *b*, Income-wise response. *c*, Food habits. *d*, Response based on same or different types of oil used throughout the year.

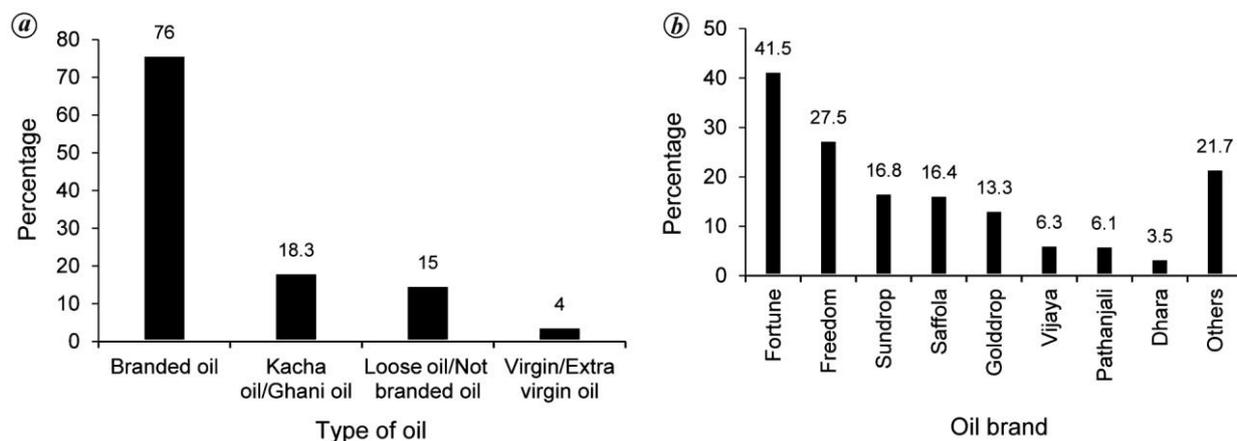


Figure 4. Different types of oil consumed. *a*, Oil types used. *b*, Brand-wise consumption.

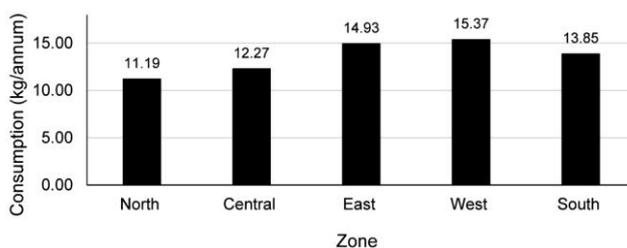


Figure 5. Zone-wise consumption pattern.

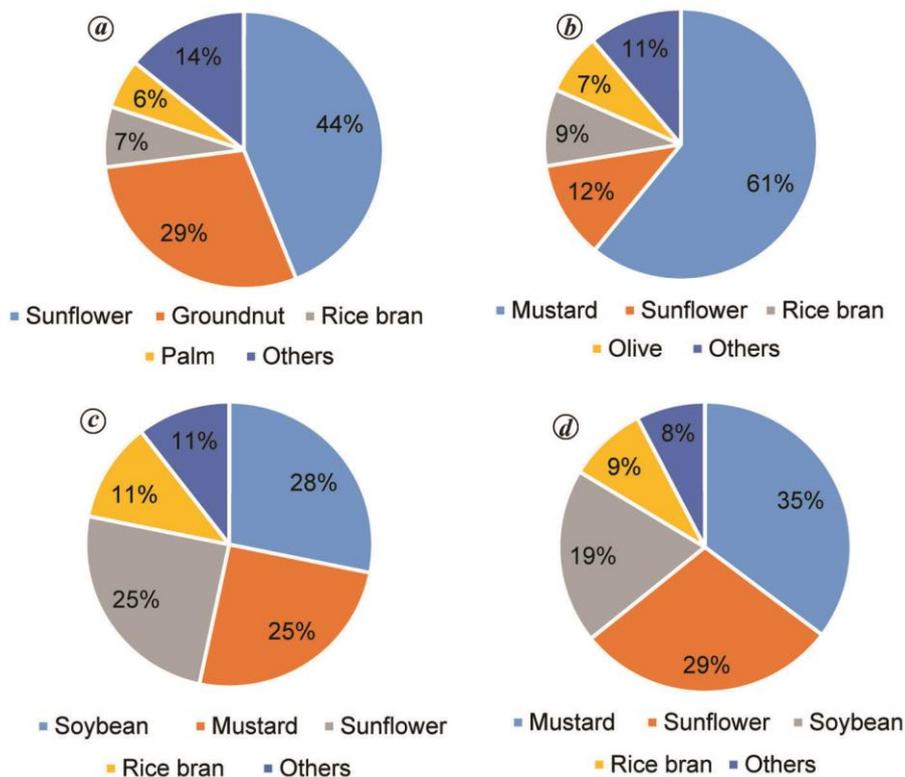


Figure 6. Crop-wise oil consumption pattern. *a*, North India (Delhi, Punjab, Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh). *b*, South India (Telangana, Andhra Pradesh, Tamil Nadu, Karnataka, Kerala, Goa). *c*, West India (Gujarat, Maharashtra, Rajasthan, Madhya Pradesh). *d*, East India (West Bengal, Odisha, Bihar, Assam and other North Eastern states, Jharkhand).

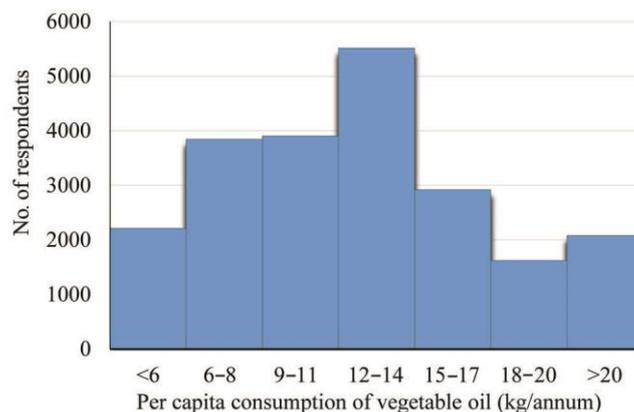


Figure 7. Per capita consumption of vegetable oil.

Annexure 1. Oil consumption survey by ICAR-IIOR, Hyderabad

1. Name _____
2. Place _____
3. State _____
4. Area: Urban() Rural()
5. Number of family members _____
6. Income per year (optional) 1–5 lakhs() 5–10 lakhs() >10 lakhs()
7. Food habit type: Vegetarian() non-Vegetarian ()
8. Cooking oil consumption per month (in kg) _____
9. Type of oil used (can select more than one option also): Branded oil () loose oil/not branded() kacha oil/ghani Oil() virgin/extra virgin oil()
10. If branded, mention the name of the brand/brands: Dalda() Dhara() Fortune() Freedom() Gold drop () 24Mantra() Nutralite() Nutrifit() Pathanjali() Priya() Saffola() Sundrop() Vijaya() Idhayam() AS brand() Delmonte() Others()
11. If others mention the name of the brand _____
12. Source of oil used for cooking (can select more than one option also): Coconut() groundnut() mustard() niger() olive oil() palm oil() Rice bran oil() Safflower() sesamum/til() Soybean() Sunflower () Blended oil() Vanaspathi/dalda() linseed oil (alsi/flax seed oil)() any other()
13. If any other, mention the name of the other oil _____
14. Whether used same type of oil throughout the year: Yes() No()
15. Oil used for other purposes (pooja, hair oil, massages, etc.) quantity per month (kg) _____
16. Average butter/ghee consumption (kg/month) _____
17. Out of home consumption (sweets/pickles/bakery products/snacks, etc.): Yes() No()
18. If yes, frequency of consumption _____

Changes in consumer dynamics like growing health consciousness and urbanization are bringing the next wave of growth for the edible oil industry. Further, the changing eating habits, ready-to-eat packaged food and the rising trend of eating out are expected to foster India's edible oil consumption. The growing share of the organized sector also supports the evident changes in consumer dynamics that generate higher demand for the sector. Strong and appealing marketing strategies by leading edible oil brands, increasing disposable income, a shift in consumer preference toward branded oils and the easy availability of packaged oil in the country have contributed significantly to the increase in edible oil consumption.

Groundnut, sunflower, sesame, niger, soybean, rapeseed, mustard and other oils are used in Indian cooking. By 2027,

mustard oil is likely to lead the market due to its high consumption and health benefits. However, soybean oil continues to gain market share in India. Zone-wise, the Indian edible oil market is divided into North, South, East and West India. Due to the rising population and growing economy, North India is predicted to dominate the market by 2027. The East and West regions also account for a significant market share, with the southern region having the smallest market share. The following initiatives need to be taken to meet the demand and supply of oilseeds in the near future.

Enhancing productivity by mapping of the potential districts and aggressive demonstration of available technologies in oilseeds along with supporting for all critical inputs to farmers and development of complete value chain of oilseed

crops, improves the seed replacement rate and variety replacement rates among farmers. Horizontal area expansion of oilseed crops in paddy–fallow, potato–fallow, turmeric–fallow, the North East region and command areas as the second crop and intercropping in pigeon pea, sugarcane, sorghum and cotton. Crop diversification in paddy–paddy systems of the southern states with paddy–oilseeds. Encourage the use of micro-irrigation systems in oilseed crops by providing subsidies on micro-irrigation, specifically for oilseed crops.

Dynamic policy support by an effective procurement mechanism at minimum support price for encouraging farmers to cultivate oilseed crops. Appropriate policy interventions to encourage domestic production of oilseeds and discourage imports by imposing quantitative restrictions, dynamic tariffs and reducing the credit period. Setting up of processing facilities in traditional and non-traditional areas to reduce the supply chain length, creating local demand and encouraging local consumption.

Creating awareness among consumers for optimum use of edible oil to maintain per capita consumption at the recommended levels.

This online survey determined oil consumption by the rural and urban Indian households. Total per capita oil consumption was 14.43 kg per annum. Based on the edible oil consumption survey, the NE region consumed less oil (11.09 kg per annum), followed by the north zone (11.19 kg per annum). The south, central, west and east zones consumed 13.85, 12.27, 15.37 and 14.93 kg per annum respectively.

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***In silico* evidence for extensive Ser/Thr phosphorylation of *Mycobacterium tuberculosis* two-component signalling systems**

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***Mycobacterium tuberculosis* has the innate ability to adapt and survive the intracellular environments during infection. Two-component signalling (TCS) systems and serine (Ser)/threonine (Thr) protein kinases facilitate metabolic and growth adaptation by directing transcriptional reprogramming in response to environmental stimuli. Presently, little is known about the post-translational regulation of TCS proteins through O-phosphorylation. Using the NetPhosBac 1.0 *in silico* tool, we screened components of *M. tuberculosis* TCS systems for potential Ser/Thr phosphosites. We report extensive Ser/Thr phosphorylation of sensor kinases and response regulator proteins, suggesting that it might be a distinct mechanism enabling the co-regulation of pathways impacting adaptive changes in mycobacterial growth and metabolism.**

Keywords: *Mycobacterium tuberculosis*, post-translational modification, serine/threonine protein kinase, two-component systems response regulators.

TUBERCULOSIS is a respiratory disease caused by *Mycobacterium tuberculosis*, an intracellular pathogen responsible for about 1.5 million deaths every year¹. The pathogenic success of *M. tuberculosis* lies in its ability to adapt and survive the changing growth environments during infection. Signal transduction systems are central to this adaptability and are known to play a vital role in mycobacterial pathogenesis, virulence and persistence. There are two major arms of signalling pathways in mycobacteria, namely the traditional two-component signalling (TCS) systems and the ‘eukaryotic-like’ serine (Ser)/threonine (Thr) protein kinases (STPKs)^{2,3} that regulate diverse cellular pathways like cell division, transport, metabolism, persistence and virulence.

Typically, a TCS system comprises a sensory component – histidine sensor kinase (SK), and a response generating component – response regulator (RR)⁴. This paired system facilitates the adaptation and survival of bacteria under different environmental stress conditions like nutrient starvation, hypoxia, nitrosative and oxidative stress (reviewed in Brett *et al.*⁵). The environmental stimulus is detected by the N-terminal variable ‘input domain’ of SK, which leads to

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