Abstract
ABSTRACT

Organic foods are produced using organic agricultural practices which avoid or largely exclude the use of chemical fertilizers, synthetic pesticides, growth regulators, genetic engineering and sewage sludge. Organic farming practices aim at enhancing biodiversity, genetic diversity and soil biological activity to achieve an optimal natural system. Agricultural practices can affect nutritional quality, sensory attributes and safety aspects of any crop. At the same time, public concerns regarding nutridense and safe food are increasing. Hence the present investigation was planned to study nutritional quality, antioxidant activity, level of pesticide residue and sensory quality of organically and conventionally grown foods. Awareness of consumers and farmers along with their attitude towards organic foods was also studied.

Total seventy eight food commodities from organic and conventional origin comprising seven leafy vegetables, six roots and tubers, eight other vegetables, four gourds, ten fruits, ten cereals, ten pulses, seven split pulses, ten spices and condiments and four miscellaneous foods were analyzed for nutrients and bioactive compounds. All the organically grown foods selected for the study were procured from certified organic farm/store. Similar varieties of conventional origin were procured from local farms and market of or Ahmedabad. Organic and conventional food samples were analyzed for moisture, ash, calcium, iron, phosphorus, ascorbic acid, β-carotene, protein, fat and total phenol, flavonoid and total antioxidant capacity using standard methods. Organically green leafy vegetables showed an average 12.81% higher ash, 56.25% higher calcium, 35.74% higher iron, 8.23% higher phosphorus, 13.47% higher ascorbic acid, 18.33% higher β-carotene, 42.51% higher total phenol, 26.48% higher flavonoid and 80.10% higher DPPHRSA. However, moisture content was noticed 2.63% lower as compared to their conventional counterparts. Similarly, organic roots and tubers showed about 24.59% higher ash, 41.62% higher calcium, 61.62% higher iron, 46.76% higher phosphorus, 26.13% higher ascorbic acid, 43.85% higher total phenol, 62.60% higher flavonoid. But moisture and total antioxidant capacity were observed 0.52% and 3.40% lower in organic roots and tubers as compared to conventional roots and tubers.
Organically grown gourds were found with average 24.07% higher ash, 47.89% higher calcium, 95.64% higher iron, 34.26% higher phosphorus, 43.54% higher ascorbic acid, 19.35% higher total phenol, 55.28% higher flavonoid content and 16.59% higher DPPHRSA. A little difference in moisture content was observed i.e. 0.94% lower in organic gourds as compared to their conventional counterparts. Among other vegetables, organically grown vegetables showed an average of 5.05% higher ash content, 38.14% higher calcium content, 19.02% higher iron content, 0.54% higher phosphorus content, 29.34% higher ascorbic acid content, 43.81% higher total phenol content, 50.99% higher flavonoid, 58.74% higher values for DPPHRSA in comparison with conventionally grown other vegetables. Also, moisture content was observed 2.71% lower in organic vegetables.

Among fruits, ash content was observed 26.56% higher ash content, 17.19% higher calcium content, 98.60% higher iron content, 12.67% higher phosphorus content. Organic fruits also showed 40.42% higher ascorbic acid, 7.5% higher total phenol content, 59.39% higher flavonoid and 64.93% higher values for DPPHRSA.

Among cereals, organically grown cereals contained 18.48% higher ash, 8.00% higher fat content, 21.38% higher calcium, 11.80% higher iron content, 14.25% higher total phenol content, 78.07% higher flavonoid content and 8.33% higher DPPHRSA. However, organically grown cereals were found with 0.30%, 4.74% and 10.71% lower contents of moisture, protein and phosphorus respectively. Among pulses, similar trend was observed for moisture and protein. About 2.74% and 8.50% lower content of moisture and protein respectively were observed for organic pulses. While organic pulses showed average 9.61% higher ash, 43.53% higher fat, 38.98% higher calcium, 23.84% higher iron, 36.27% higher total phenol, 28.74% higher flavonoid and 12.68% higher DPPHRSA were observed for organic pulses and split pulses. Among split pulses, an average of 29.21% higher fat, 7.60% higher ash, 13.60% higher calcium, 3.58% higher iron, 2.54% higher phosphorus, 32.50% higher total phenol, 19.14% higher flavonoid content were observed for organic ones. While conventionally grown split pulses showed 4.80% higher moisture, 7.16% higher protein and 1.15% higher DPPHRSA as compared to their conventional counterparts.
Among miscellaneous food commodities, organic jaggery showed significant (p<0.05) higher content of ash, calcium, iron and flavonoid while lower content of moisture and phosphorus than conventional jaggery. Organic honey showed significant (p<0.05) higher content of moisture, iron, total phenol and flavonoids in comparison with conventional ones. Phosphorus content was found significantly (p<0.05) lower in organic honey. Organic and conventional sesame seed significantly (p<0.05) differed in moisture, ash, iron, total phenol and flavonoid contents. For groundnut, ash, calcium, iron, total phenol and flavonoid significantly (p<0.05) varied while comparing organic and conventional methods. Results for green tea indicated that organic green tea showed significant (p<0.05) higher values of total phenol, flavonoid and DPPHRSA.

For the comparison of pesticide residues among organically and conventionally grown foods, total 17 food samples comprising of 9 vegetables, 4 fruits and 4 cereals and pulses from organic and conventional cultivation systems were selected on the basis of usage of pesticides as well as regular consumption. These samples were analysed for total 52 pesticides. Out of 52 pesticides, 20 organochlorine 17 organophosphates and 7 synthetic pyrethroids and 7 herbicide residues were analysed using Gas Chromatography at Pesticide Residue Laboratory (NABL accredited), Anand Agricultural University, Anand. Organically grown Indian beans and green chillies were found to be contaminated with \( \gamma \)-HCH (0.003 ppm) and pp'-DDD (0.005 ppm) respectively. Among conventionally grown vegetables, Indian beans were found to be contaminated with the residues of \( \alpha \)-endosulphan (0.004 ppm), \( \beta \)-endosulphan (0.053 ppm), endo-sulphates (0.004 ppm) and chlorpyriphos (0.001 ppm). Green chillies were contaminated with the residues of \( \alpha \)-endosulphan (0.001 ppm), \( \beta \)-endosulphan (0.04 ppm), endo-sulphates (0.039 ppm), chlorpyriphos (0.001 ppm), profenophos (0.002 ppm) and ethion (ppm). Spinach was contaminated with the residues of fenvalarate-I (0.004 ppm) and fenvalarate-II (0.002 ppm), deltamethrin-I (0.011 ppm) and deltamethrin-II (0.002 ppm). Okra contained L-cyhalothrin (0.045 ppm) residues. Among fruits, conventional amla was found to be contaminated with residues of endosulphan (0.001 ppm) while conventional lemon was contaminated with Me-parathion residues (0.0021 ppm). All the organically grown fruits did not show the contamination with any pesticide residue. In cereals and pulses,
conventionally grown green gram (whole) was contaminated with 0.0269 ppm of sum of fenvalerate-I and II. No pesticide residues were detected in organic and conventional grains and pulses namely wheat, rice and red gram splits.

For sensory evaluation, a panel of fifteen semi-trained judges evaluated sensory quality of organic and conventional foods using composite scoring test. Organically grown green leafy vegetables as well as some coloured vegetables like beet root, fresh turmeric, capsicum, cowpea, cluster beans significantly (p<0.05) differed for colour score as compared to their conventional counterparts. Similarly organically grown mango (ripe) and papaya showed significantly (p<0.01) higher scores for colour. Five organic samples (ripe mango, custard apple, spinach, coriander leaves and radish) got higher scores for flavour as compared to conventional ones by sensory panel. Organically grown ripe mango, banana, coriander leaves, mint leaves, radish, beetroot, drumstick, cauliflower and cowpea showed significant (p<0.05) higher scores for taste as compared to conventional ones. Among cereals, the score for appearance was noticed significant (p<0.05) higher for organic finger millet and for flavour it was observed higher for conventional pearl millet as compared to their counterparts. Among pulses and split pulses, organic black gram splits showed significant (p<0.05) higher scores for appearance as compared to conventional black gram splits with husk.

For farmers’ survey regarding organic farming, a self-prepared questionnaire was sent to 75 organic farmers in different parts of Gujarat. It was observed that the average duration when the respondent farmers initiated organic farming is 12.93 years and about 72 % of the farmers are practicing organic farming in 100% of their land area. About 56% farmers had switched to organic farming after keeping 3-4 years of wash off period. Farmers were using various natural and bio-fertilizers like cow dung, vermicompost, plant waste, castor oil seed cakes. For crop protection, various natural components like cow urine, the upper layer of buttermilk, boiled extracts of plants; self-prepared bio pesticides as well as bio pesticides available in market were used. About 72% have not applied for organic certification as they found it as an expensive issue. The main crops as per the study were cereals, pulses, seasonal fruits and vegetables, sugarcane, spices and condiments as well as cotton and fodder.
To study the awareness regarding organic foods among consumers of Gujarat, a self-prepared questionnaire was administered to 900 consumers of four major cities of Gujarat namely Ahmedabad, Vadodara, Rajkot, and Surat. About 81.22% of consumers were aware of organic foods. Majority of the respondents mentioned that organic foods are grown without pesticides and chemical fertilizers and many of them considered organic food as natural and fresh foods. Total five attitude factors were noticed namely quality and trust, health and environment consciousness, cost and acceptability concerns, identification and availability of organic foods and importance of organic certification were derived. These factors significantly (p<0.01) affected the overall attitude score regarding organic foods. 450 were organic food buyers whereas out of 450 non-consumers of organic foods, 60% were willing to buy organic foods. Safety aspect and better quality were found to be important reasons for selecting organic foods. Insufficient information and availability issues were the issues for not purchasing organic foods. Cereals, pulses, millets, legumes, seasonal fruits and vegetables, honey, jaggery, groundnuts, sesame seed oil, cow's ghee, and spices were the commonly purchased food commodities by organic consumers.

Overall, organically grown foods have higher nutrients and antioxidant potential with good sensory acceptability. Organic foods were found safer and also conventionally grown plant foods in the present study were comparatively safer for consumption. Consumers were well aware of organic foods and they were found to be conscious about food quality and food safety. Hence it is concluded that organically grown foods serve better quality in terms of nutrition, antioxidants and sensory quality which could be considered as a safer alternative to achieve nutrition security and helpful for maintenance of better health.