Introduction
1.0 Introduction:

*Let food be thy medicine and medicine be thy food.*

— Hippocrates

Food is considered as a fuel for life as it provides all essential nutrients required for maintenance of health. They also serve micro-nutrients, fibres, and antioxidants. Consumption of all these functional compounds is helpful to prevent various non-communicable chronic diseases such as cardiovascular diseases, diabetes, cancers, and other diseases (Subhashree et al., 2009; Iyer et al., 2009; Sarwar et al., 2013). Hence, the quality of food is important to improve the quality of life. Nowadays, public concerns regarding nutridense and safe food are increasing. Also, environmental consciousness has increased among the people. As a result people have started giving preference to eco-friendly products and practices. All these issues have raised a gradual demand for sustainable development in agricultural field. But at the same time, to feed the adequate food to humankind, modern agriculture has come into existence since last few decades which allows the use of various agrochemicals. This has promoted excessive use of insecticides and pesticides which has certainly increased the production of food materials however it has adversely affected the quality of food, soil and environment.

The intensive chemical agriculture that has been followed after green revolution success is causing heavy pollution of our food, drinking water, air. Overall the life expectancy has improved, but the quality of life has substantially deteriorated

(GOI, 2001)

Hence, it becomes essential to save the environment, plants and animals, including human beings by adopting eco-friendly products and practices. All these issues have created a gradual demand for sustainable development in agricultural field. Sustainable agriculture is the successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the quality of the environment and conserving natural resources. Sustainable agriculture is necessary to realize the goal of sustainable development.
Organic farming is considered as a more sustainable method of agricultural production than most conventional farming systems (Lampkin et al., 1999; Grey, 2000; Edwards-Jones and Howells, 2001; Michelsen, 2001; Mader et al., 2002 cited in Kings and Ilbery, 2011). Organic agriculture involves traditional methods along with the latest methods of farming practices (Alteiri, 1998). It aims to enhance biodiversity, genetic diversity and soil biological activity to achieve an optimal natural system, which is necessary for social, ecological and economic sustainability (Samman et al., 2009). It is also evident that organic farming practices have potential to mitigate climate change (OFRF, 2012). Hence, accepting organic food can be one step in the direction of minimizing the effect of deteriorating environment and promoting a healthy lifestyle.

Traditionally, organic farming was practised in India. However, the farming practices in India have increasingly been found non-sustainable for the last three decades. The use of pesticide was initiated to combat the issues related to food security and to increase food production. Hence, India has adopted modern agriculture practices in which chemical fertilizers and pesticides are being used and they have achieved significant success. This success was mainly due to the changes brought about agriculture that included high inputs of agrochemicals, water, and widespread practice of monoculture. But now the scenario has undergone change indicating that current agricultural system only emphasises on the high production without being sensitive towards ecology and the very existence of human beings (Narayan, 2005). It has been reported that the overuse of chemical pesticides and fertilizers have resulted into degradation of soil, environment and water such as soil erosion, water shortages, salination, soil contamination, genetic erosion and so on. These ill effects are not limited to the farm but they also extended to health of all living things and significantly on the environment.

This situation reversed the cycle of conventional farming to sustainable and organic agricultural system. During the last two decades, there has also been a significant sensitization of the global community towards environmental conservation and assurance of food quality. As a result, sustainable agricultural systems like organic farming, biodynamic farming and Integrated Pest Management system came into existence.
Organic farming is becoming important in the agriculture sector in India, largely through the efforts of small groups of farmers. As a result, it has got rid of ill effects of abusive agricultural practices. Various definitions which advocate organic farming as a sustainable farming are as follows.

Organic farming is a system which avoids or largely excludes the use of synthetic inputs (such as fertilizers, pesticides, hormones, feed additives etc.) and to the maximum extent feasible rely upon crop rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives and biological system of nutrient mobilization and plant protection.

**United States Department of Agriculture (USDA)**

Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasises the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, agronomic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfil any specific function within the system.

**Food and Agriculture Organization (FAO)**

Organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.

**International Federation of Organic Agriculture Movements (IFOAM)**

Organic foods are produced using methods that do not involve modern synthetic inputs such as synthetic pesticides and chemical fertilizers, do not contain genetically modified organisms, and are not processed using irradiation, industrial solvents, or chemical food additives (USDA, 2009). The use of genetic engineering, sewage sludge, and irradiation are also prohibited in organic production and processing.

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Consumers consider organic food as natural foods and they also believe it as higher quality foods with respect to health and gourmet eating (Hartman, 2006). Organic food was perceived as free of chemical and synthetic agents, superior in health implications and with a premium taste in its early development stage (Blank, 2005).

The organic foods market rapidly developed into a substantial global business in all sectors. Organic Trade Association (2006) reported that organic food sales are growing at a faster rate as compared to conventional food sales, which have been a main factor to increase overall grocery sales in recent years. This could be due to the greater interest in both a healthier and safer diet as well as for the betterment of the environment (Pelletier et al, 2013). The demand of certified organic food has also increased these days.

Organic foods are certified by various International and National Certifying Bodies such as USDA, Codex, NPOP, Indo cert, Eco cert, One cert, Food cert, India Organic, SGS India. In comparison with conventional products, certified organic products are generally more expensive. For this, many factors are responsible such as limited supply compared to demand, greater labour inputs compared to production, extra premium paid to labourers, post-harvest storage for small volumes, etc.

In many developing countries, there are agricultural systems that fully meet the requirements of organic agriculture. However, these farms are not organically certified. Non-certified organic agriculture refers to organic agricultural practices by intent and not by default; this excludes non-sustainable systems which do not use synthetic inputs but which degrade soils due to lack of soil building practices. The products of such systems are sold locally. The uncertified produce does not benefit with price premiums however some cases have reported that non-certified organic agriculture increases productivity of the total farm agro-ecosystem, and reduces a cost for external inputs. In many developed countries, non-certified organic food is often sold directly to consumers through local community support programmes such as box schemes, farmers markets and at the farm gate. These help the farmers to know exactly what the consumer wants, while the consumer knows where the produce comes from and in the case of box schemes, saves on transport costs through delivery of produce to their homes. In developed countries, non-certified organic produce
usually carries a higher price than its conventional counterpart, in accordance with the specific consumer willingness to pay (FAO, 2013).

Nowadays, nutrition quality with food safety has become a concern towards positive health among people (Magkos et al., 2006). Food safety issues have triggered the consumer awareness and people have started being suspicious about conventional products. A consumer choice between organically and conventionally grown produce suggested that organic foods are substantially less hazardous than the conventional alternatives (Winter, 2012) and are willing to pay significant premiums for the risk reduction (Aryal et al., 2009; Ghorbani and Hamraz, 2009). Regarding safety aspects, food should be rid of contaminants which can be in the form of pesticide residues, chemical fertilizers and unwanted heavy metals as it has direct adverse effects on human metabolism. Among consumers, food safety aspect of organic food is the first criterion while purchasing organic foods as they are produced with agricultural practices wherein no use of pesticides and chemical fertilizers.

A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest (Environmental Protection Agency, 2010). The main classes of insecticides are organochlorine, organophosphates, carbamates, synthetic pyrethroids and neonicotinoids. The main classes of herbicides are phoxy herbicides and triazine. India is the third largest consumer of pesticide in the world. At present 246 pesticides have been registered in India and this number increases every year. (CIBRC, 2014). The pattern of the use of pesticide use in India mainly focuses on high organophosphates and organochlorines as compared to the same of the world. However the use of synthetic pyrethroid levels is reported to be similar in comparison with other countries (Bhushan, 2006).

Pesticide residues mean any specified substances in food, agricultural commodities, or animal feed resulting from the use of a pesticide. The term includes any derivatives of a pesticide, such as conversion products, metabolites, reaction products, and impurities considered to be of toxicological significance.

A number of long persistent organochlorines and highly toxic organophosphates, which have been banned or severely restricted are still marketed and used in many developing countries. Organophosphate pesticide has become associated with acute
health problems such as abdominal pain, dizziness, headache, nausea, vomiting, skin and eye problems. Long term, low levels exposure to pesticide effects includes immune suppression, leukemia, Parkinson's disease, neurological problems, reproductive disorder, birth deformities, miscarriages, wide variety of cancers (Watts, 2012). Environmental Protection Agency (EPA) considers 60% of all herbicides, 90% of all fungicide and 30% of all insecticides which being used in conventional farming are potential cancer causing agents (OFRF, 2008).

Many reviewed studies have revealed that organic fruits and vegetables have lower levels of pesticide residues than conventional fruits and vegetables, but pesticide residues are still frequently detected in organic fruits and vegetables (Winter, 2012; Witzczak and Abdel-Gawad, 2012). Pesticide residues were found in 42% of conventionally produced and 22% organically produced food. 2.6% of conventionally grown food contained pesticide residues that exceeded the maximum residual limit (Cressey et al., 2009). Organic crops contained fewer and lesser pesticide residues in comparison with conventional ones.

However, various processing and cooking technologies such as washing, peeling, canning scrubbing of hard fruits, soaking in brine solution/ hot water were reported to reduce a specific group of pesticide residue. Yet, the risk assessment of exposure of organophosphorus pesticides could not be minimized by general processing in the Dutch diet (Boon et al., 2008). New technologies like hydrostatic pressure treatments have proved to reduce chlorpyriphos at negligible levels in cherry tomatoes (Lizuka et al., 2013). Hence, to be on a safer side, accepting organically grown foods could be a better alternative.

The other possible hazardous trait in conventional farming is the use of soluble chemical fertilizers. This has resulted in high nitrate concentrations in many conventionally farmed foods, especially in fruits and vegetables. Leafy vegetables can have the highest concentrations. The leaching of these fertilizers has also resulted in high nitrate levels in some drinking water systems around the world. High nitrate content in food and drinking water can be converted to nitrosamines that are carcinogens. Nitrates can impair the ability of the blood to carry oxygen, and may pose a risk of methemoglobinemia (Paitram cited in Singh et al., 2006). Moreover, nitrate as such has not been shown to produce a carcinogenic effect in animals, but
can be converted into nitrite by bacteria in human saliva and in the intestine, which in
turn may react with certain amines and amides, normally present in the body, to
produce nitrosamines (Bruning-Fann and Kaneene, 1993, Vermeer and Van Maanen,
2001 cited in Magkos et al., 2006). About 300 nitrosamines have been tested for
carcinogenicity in high-dose animal cancer tests, and roughly 90% of them have been
found to be carcinogenic (Havender and Coulombe, 1996 cited in Magkos, 2006).
Nitrosamines are capable of both initiating and promoting the cancer process.

Apart from safety aspects of food, nutrition and health are considered as important
reasons for selecting organic food (Nie and Zepeda, 2011). The quality of food can be
categorized into the sensory quality and nutritional attributes. Nutritional quality
attributes encompass all phytochemicals and micronutrient that influence human
health and wellbeing. Plant foods are good sources of macro and micro nutrients as
well as non-nutrient bioactive compounds. Micronutrients specifically certain
vitamins and minerals are proved to prevent various diseases related to under nutrition
and over nutrition. Antioxidants are capable of stabilizing, or deactivating, free
radicals before they attack cells. Antioxidants are absolutely critical for maintaining
optimal cellular and systemic health and well-being. Plant foods contain antioxidants
mainly in the form of polyphenol as well as certain vitamins, minerals and pigments.
Flavonoid and non-flavonoid polyphenol compounds, including ascorbic acid,
β-carotene, vitamin –E and selenium are powerful antioxidants (Birangane et al.,
2011).

Although, there is uncertainty about the degree of difference in nutrient composition
between conventionally and organically produced foodstuffs, consumers perceive
organic foods are nutridense. The organic fruits and vegetables had more of the
nutritional elements than similar commercial foods (Kelly and Bateman, 2010;
Fjelkner-Modig et al., 2000; Lima et al., 2008). Organic crops are believed to have
higher ascorbic acid, sugars, and polyphenols as well as fewer nitrates than
conventionally grown produce (Lester, 2011; Lombardi-Boccia et al., 2004). Although
organically grown wheat has lesser quantity of protein, it has better quality of protein
than conventionally grown (Smith, 1998, Vreck et al., 2014). On the other hand,
heavy metal compounds are found less in organically produced compared to its
counterparts (Worthington, 2001).
The organically grown plant foods are reported to have higher antioxidants compared to conventionally grown ones. Organic food is equivalent to have an extra portion of fruits and vegetable a day. Organically grown foods have higher polyphenol and flavanoid content which are needed for the maintenance of good health and to prevent cell damage (Brandt and Molgard, 2001 and Carbonaro and Mattera, 2001). Organic fruits and vegetables contain 60% more phytochemicals. Certain organic crops appear to have higher contents of phytoneutrients, such as polyphenols, lycopene, flavonols, resveratrol, quercitin, catechin, anthocyanin (Dani et al., 2007; Carbonaro et al., 2002; Vallverdu-Queralt et al., 2012). Moreover, some organically cultivated vegetables were reported to have significantly higher levels of antimutagenic activity than their conventional counterparts (Ren et al., 2001).

The consumer demand is increasing for higher quality food products, where quality consists of different dimensions such as taste and appearance along with health, convenience and process (Brunso et al., 2002). In the acceptance of any food, the sensory aspects are very important. The chemical composition of any food such as dry matter, soluble solids, sugars and total titratable acids may be relevant for the prediction of sensory quality (Haglund et al., 1999). Sensory quality attributes such as flavour, texture, mouth feel, and colour can affect acceptance and consumption of food. Freshness and taste are considered as two important traditional observation traits for all consumers. It is apparent that organically and ecologically produced foods 'taste better' than conventionally produced foods (Saba and Messina, 2003; Wier et al., 2008).

Regarding the purchase of organic produce by the consumers, many factors are responsible. The purchasing intentions and purchasing behaviour among the consumers are affected by factors such as health consciousness, food quality, safety concerns, knowledge regarding foods, availability, convenience, ethical concerns, ecological concerns, economic concerns, value, trust, attitude towards products (Lockie et al., 2002).

The determinants of increasing levels of organic food consumption such as motivation, behaviour, beliefs and demographic variables are most essential in understanding the potential of the organic market to keep up the increasing growth and become genuinely a mainstream market (Shafie and Rennie, 2012). Consumers'
attitude towards health hazards often follows an emotional route instead of a rational statement (Morasso et al., 2000). Nowadays, educated people are showing greater interest in their personal health and the health of their children. Hence, they prefer natural products and foods with more nutritional values and less additives (Mutlu, 2007). Social and ethical concerns which are inculcated by cultural and social values are more important in selecting organic foods compared to scientific evidences (Morasso et al., 2000). On the other side, some have reported a poor relation between ethical values, attitudes and food choices. The main characteristics of organic food consumers are concerned for health, nourishment and the environment, along with better organoleptic qualities. It has also been noticed that ecological value of an individual has resulted in product preferences (Roitner Schobesberger, 2008; Zander and Hamm, 2010; Hjelmar, 2011).

Personal values are one of the important factors found to influence the organic food choice (Baker et al., 2004) as women have a more favourable attitude for the purchase and consumption of organic food than men, whereas men are inclined to pay a higher price for organic foods (Urena et al., 2008). On the other side, adolescents are found to have positive attitudes towards organic foods, but their knowledge and their willingness to buy organic food are low (Stobbelaar, 2007).

In comparison with general public, food cooperative members had stronger attitude and concerns about food and environmental issues which result in to higher preference and more frequent consumption of organic food (Wilkins and Hillers, 1994). Moreover, consumers of developed countries pay more attention to organic products (Mutlu, 2007). An increased consumer demand for organic food has made the organic food market as a developed field into a substantial global business in all sectors. The organic industry has become one of the fastest growing business segments in the global market.

This is reflected in higher production of organic foods. Over the past decade, the organic food industry has grown considerably on a worldwide basis and has been the subject of much media attention. The organic agriculture has grown almost 29 fold by 2010 in comparison of 42,000 ha in 2003-04 under certified organic farming. The
countries with the highest numbers of producers of organic foods are India (340,000 producers) followed by Uganda (180,000 producers) and Mexico (130,000 producers) (BioFach Global Survey, 2010). As per Organic Trade Association (2006), the organic foods with higher sales are vegetables, fruits, dairy products, grains and pulses, beverages and other processed products worldwide.

The growth of organic agriculture in India has three dimensions and is being adopted by farmers for different reasons. The organic farmers in the first category are those who are traditionally involved in organic farming, for them organic is a way of life and they are doing it as a tradition. These farmers are the majority in India and most of them not having organic certification. The second category of farmers are those who have converted their farming pattern from conventional to organic due to ill effects of conventional agriculture, may be in the form of reduced soil fertility, food toxicity or increasing cost and diminishing returns. This category of farmer comprised both certified and non-certified. The third category of farmers is more technical who have systematically adopted the commercial organic agriculture to capture emerging market opportunities and premium prices. In this category, majority of the farmers are involved with certified organic agriculture (Yadav, 2012).

**Rationale of the study:**

Many research and review studies reveal that organic produce contain lower levels of pesticide residue and heavy metals. Moreover, some studies have also revealed that organically grown foods possess higher amount of bioactive compounds. Hence, the present study aimed at carrying out a comparative study on consumer perception, sensory attributes, nutrients and pesticide residue level among organically grown foods and conventionally grown foods. Internationally, much work has been carried out on a comparison of selected nutrients and antioxidant (Worthington, 2001; Bourn and Prescott, 2002; Crinnion, 2010), pesticide residue level (Baker, 2002; Cressey, 2009; Winter, 2012) among organic and conventional foods as well as various studies have been also done on consumer awareness and perception regarding organic foods. Rather, in India, a few studies have been taken up on pesticide residue (Rekha et al., 2006), nutritional comparison (Nikita et al., 2008; Venkatasubramanian, 2011) and consumer awareness and attitude regarding organic foods (Kumar and Ali, 2011, Sarkar et al., 2012). However, there is a lack of information on comparison on
nutritional profile, non-nutritive bioactive compounds, pesticide residue level, sensory profile as well as awareness of organically and conventionally grown foods among the consumers in India especially in Gujarat. Hence the present study is planned with the following objectives:

- To evaluate nutritional value of organic and conventional foods
- To study non-nutritive bioactive compounds in organic and conventional foods
- To compare pesticide residue level in organic and conventional foods
- To evaluate sensory attributes of organic and conventional foods
- To collect the information on availability, types, producers, retailers, and consumers of organic foods
- To study the consumer perception and knowledge regarding the organic foods