



INTRODUCTION

CHAPTER 1

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Humankind has faced major shifts in dietary and physical activity patterns since paleolithic man evolved on Earth. Emergence of agriculture, modernization and urbanization has played a pivotal role in bringing about this change. Decades of research in the developed world have shown that much of the burden of chronic diseases is attributable to environmental and lifestyle factors, including dietary shifts and decreased physical activity. Variation in the risk of non-communicable diseases between high income countries and changing trends over time within the developing countries also indicates that the factors determining their incidences must be modifiable (Tullao TS, 2002). The World Health Organization (WHO) predicts that deaths due to circulatory system diseases are projected to double between 1985 and 2015. Increased intake of energy dense foods, along with lifestyle changes in the developing world has increased the focus on diseases of aging (Vaz M et al, 2007; Drewnowski A and Darmon N, 2005). Foreign distribution channels bring foreign diets, i.e. processed foods rich in sugars and fats and in general energy dense food (Shetty P and Schidhuber J, 2005). Additionally, production and easy availability of such foods has led to its increased consumption.

Fueled by urbanization and the advent of the global economy, these changes in eating patterns are the most rapid and dramatic in the course of human history. The term "Coca-colonization," a reference to the ubiquitous presence of Coca-Cola, Pepsi, and McDonald's, describes a world that is moving toward a common diet, one accompanied by the more sedentary lifestyles associated with increased risk of chronic disease (Zimmet P, 2000).

"Nutrition transition", the consumption of foods high in fats and sweeteners is increasing throughout the developing world, while the share of cereals is declining; intake of fruits and vegetables remains inadequate. The dietary

transitions taking place are deeply rooted in the processes of globalization (Hawkes C, 2006). Globalization is associated with changing incomes and lifestyles. The concept of the nutrition transition focuses on large shifts in diet and activity patterns, especially their structure and overall composition. These changes are reflected in nutritional outcomes, such as changes in average stature and body composition.

Women who report a higher standard of living, who live in households where at least one member is educated beyond high school, who work in non manual occupations, or who watch television more than once a week are more likely to be overweight or obese. These factors are all inversely related with low BMI. In common with other studies in developing countries that are in the early stage of nutrition transition, Indian women in the highest socioeconomic groups are more likely to be overweight or obese, whereas nearly half of poor women are underweight (Singh RB et al, 1999; Dhurandhar NV and Kulkarni PR, 1992). According to analysis on morbidity trends, developing countries like India, Brazil and China are in the rapid transition phase because of large increase in non-communicable diseases.

India has been called the land of *Annapurna*, is a vast and varied subcontinent, with 2.4 per cent of its global landmass supporting over one-sixth of the world's population (Ramachandran P, 2008). In a recent report by United States Department of Agriculture (USDA), India used 1,000 and 1,440 thousand metric tons of cottonseed and groundnut oil respectively for domestic consumption (USDA, 2010). Report by Nutrition Foundation of India (2008), reveals high fat consumption in prosperous urbanized states like Gujarat, Haryana, and Punjab. However, states like Orissa, Chattisgarh and Assam consume lesser fat (Ramachandran P, 2008). National sample survey organization, Government of India, reported that population of Gujarat consume 25kg/capita of oil every year, while the national average is only 11kg/capita. This epitomizes a clear picture of Gujarati population consuming the highest edible oil in our country (NSS, 2007). However, due to

increasing awareness of consequences of consumption of energy dense foods, there is a need to document the source of energy especially with respect to edible oil.

Frequent/high oil or fried food intake is one of the reasons for increased prevalence of obesity, diabetes and CHDs all over the world (Weisburger JH, 2000; Mozaffarian D and Willett WC, 2007). Increased prevalence of abdominal obesity, hypercholesterolemia and T2DM (Type 2 Diabetes Mellitus) and low levels of HDL-cholesterol is also reported in Indian population (Misra A et al, 2001; Ghafoorunissa G, 2008). According to analysis on morbidity trends, developing countries like India, Brazil and China are in the rapid transition phase because of large increase in non-communicable diseases (WHO, 2008).

Use of Groundnut and Cottonseed oil for cooking various foods is very popular in western region of India especially Gujarat.

A major portion of vegetable oils produced in our country is utilized for frying food. Frying uses fats and oils as a heat transfer medium, where a crust is formed which seals in the water keeping the centre moist and reducing fat uptake. Several factors such as prolonged heating, high temperatures (150-200^o C), oxygen, moisture content, presence of light, and impurities are known to cause hydrolysis, oxidation and polymerization of fats that may result in darker fat, strong flavors, lower smoke point, foaming and viscosity (Singh S and Tyagi VK, 2001; Aladedunye FA and Przybylski R, 2009; Dobarganes C, Márquez-Ruiz G and Velasco J, 2000; Saguy IS and Pinthus EJ, 1995).

Amongst the various cooking methods, deep frying is popularly used in India for preparing snacks and savories (Gupta A and Sheth M, 2011). Normally deep fat frying produces a product with desirable sensory characteristics, including fried food flavor partly derived from the formation of 2, 4-decadienal during thermal oxidation of linoleic acid (Warner K, Orr P, and

Glynn M, 1997). Another change commonly encountered during frying is development of golden brown color as the result of maillard reaction which depends on the content of reducing sugars and amino acids or proteins at the surface, temperature and time of frying. Crispness, which is also a desirable quality of fried foods can be used as a quality indicator of freshness (Scanlon MG et al, 1994; Warner K, 2004). In addition, German Society for Fat Research has recommended that frying research should accompany sensory evaluation of fried product because formation of different decomposed products may cause alteration in the nutritional quality of oil and sensory quality of fried product as well (DGF, 2000).

The popularity of food prepared using repeatedly heated oils persists despite public concern about fat, cholesterol and the knowledge that fat intake should be in moderation and of good quality. Deteriorated oils are not only insidious cause of cancers, hypertension and coronary heart diseases but also result in foods with poor texture, flavor and shelf stability (Singh S and Tyagi VK, 2001; Soriguer F et al, 2003; Tsai WC et al, 2004; Goyal N and Sundararaj P, 2009).

Thermo oxidative stability of various oils is extensively studied by several researchers (Houhoula DP, Oreopoulou V and Tzia C, 2002; Warner K and Gupta M, 2003). However, most of the studies have been carried out with intermittent time periods of 80-90 h, and little attention is given to researches where the intermittent frying time matches the duration used at household and restaurants level.

Access to safe food has been man's main endeavor in order to live a healthy life. Safe food may be defined as, "a product which contains no physical, chemical or microbiological organisms or by products if consumed by man will result in illness, injury or death-an unacceptable consumer health risk" (Stier FR, 2000).

Rapid industrialization and change in life styles of people has resulted in marked increase in the consumption of food outside the house. Large numbers of eating establishments such as restaurants, fast food centers, dhabas, street food stalls, etc have mushroomed in cities of India, which are manned by different categories of workers (Sukul S and Sheth M, 2009). These eating places are frequented by both middle and high-income families with their children. Today eating out has become an important social activity, both at personal and professional levels due to changing dietary and lifestyle practices (Goyal N and Sundararaj P, 2009). Unhygienic preparation of food in such places provides ample opportunities for contamination, growth, or survival of food borne pathogens that may lead to diseases commonly referred as food borne illness (Gurudasani R and Sheth M, 2009).

According to Mazumdar S (1992) in catering establishments 40% of the food borne illness is caused by mishandling of food and cross contamination. The importance of safe food for health and development has been recognized and addressed in many international forums as well. Safe food is one of the three essentials for maintenance of life and health.

Apart from the microbial safety of foods, chemical changes in food during processing needs to be looked upon for their nutritional safety. Agreements in the form of legislation must be put in place in order to ensure that safe and healthy food reaches to consumers.

Because of unavailability of frying regulations in India, cooks in restaurants refry the same oil a number of times. Therefore frying regulations need to be established in India and monitored strictly which may help in reducing the rising trend of non-communicable diseases (NCDs) in India. Furthermore, it is necessary to elicit data on food safety practices performed at various food outlets in India to reduce the prevalence of food borne illnesses especially in relation to their hygiene and frying practices.

Thus present study entitled "Occurrence of chemical and sensory changes during intermittent frying of french fries and bhajias in Groundnut and Cottonseed oil and studying the association between the fried food intake by the Gujarati housewives and Non-communicable diseases" was undertaken in five phases:

PHASE I: Fried food intake, knowledge on fats and oils and frying practices of the Gujarati housewives of urban Vadodara and its association with the prevalence of NCDs.

PHASE II: Sensory qualities of french fries and bhajias fried in cottonseed oil (CSO) and groundnut oil (GNO) during intermittent frying.

PHASE III: Chemical changes due to thermal degradation of intermittently deep fried cottonseed oil (CSO) and groundnut oil (GNO) as a result of french fries and bhajias frying.

PHASE IV: Case study on prevailing food safety and frying practices in Jan aahar- A Government run food outlet at Vadodara railway station.

PHASE V: Development of Nutrition Health Education (NHE) material in two languages on intake of edible oil, types, and on choices of oils for healthy living and problems during frying of edible oil and its storage.