Research Article

Refrigerated Food Storage Practices in Relation with Food Borne Disease Incidences Among Consumers

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Abstract

The study aims to assess the food storage practices regarding refrigerated foods among the respondents of Ludhiana district (Punjab) and to relate it to the incidence of food borne diseases. Results revealed that female respondents had good storage practices as compared to male respondents. Educational qualification did not affect the adoption of good food storing practices as the respondents with lower educational qualifications (12^{th} standard and graduates) had better refrigerated food storing practices as compared to the post graduates. A better food storage practices towards food safety was found in the respondents who were from nuclear families and belonged to the service class. The storage time of different commodities in the refrigerator was assessed ranging from less than 4 hours to period of 1 week. Most of the perishable food items were stored in the refrigerator for 4-12 hours followed by raw fruits and vegetables (2-3 days) and processed/frozen foods (1 week). Good storage practices were significantly negatively correlated ($p<0.01$) with the food borne disease incidences.

Practical applications- Refrigeration storage is one of the most widely practiced methods of controlling microbial growth in perishable foods. But the practice of storing food in the household refrigerator is over exploited (in terms of time and temperature) by the consumers which further give rise to increase in food borne disease incidences. Therefore proper implementation of storage of food at appropriate temperature and duration of time in the refrigerator is the two cornerstones for preventing microbial contamination and to keep food safe for human consumption.

Keywords: Food safety, refrigerated foods, storage practices, perishable foods, food borne disease incidence

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Introduction

Safe storage of food is considered as a major issue, when it comes to keeping the food safe from microbes and preserving its nutrition. Food which is not correctly stored can either spoil or become contaminated and can further lead to food borne illness among consumers. Safe food is a basic human right which should be free from microbiological, physical or chemical hazards and does not cause any sickness or injury when consumed as intended [1]. It not only promotes physical wellbeing but also leads to increased economic benefits through productivity. Therefore, food safety has become a public health concern globally due to invasion and spread of food borne illnesses. As a result, consumers are more and more concerned about food safety and quality; and claim more precision in production and distribution of food from farm to folk [2]. Most of the times, consumers associate food borne illness with consumption of food outside the home. But it is reported to have initiated in home setting three times more frequently than in the commercial operations [3]. Many of these researches regarding household's food borne illness are attributable to improper storage of food, lack of safe food handling procedures, poor cleanliness and proper management of the refrigerator in terms of cleanliness and temperature control [4]. Bacteria from unwashed raw foods, leaking packages, contaminated hands and unclean container surfaces stored into domestic refrigerators can directly contaminate other foods stored in the refrigerator and stick on the internal surface of the refrigerator [5]. Ensuring that food is stored in the refrigerator properly goes a long way towards maintaining a high level of food safety and keeping the health of all the family members safe. Perishable food items like dairy products, fruits, vegetables, meats and fish products needs to be kept in a chilled or frozen state along the entire supply chain so as to extend their shelf life and also provide safe food to the consumers. Failing to keep perishable food in the desirable temperature range, because of insufficient refrigeration, can stimulate the growth of food borne pathogens and spoilage microorganisms and spoils the food and render it inedible [6]. Various studies have also indicated that there are high chances of ready-to-eat products to be cross-contaminated through contaminated surfaces of the refrigerator [7]. Many foods must be stored in the refrigerator ($4^{\circ}C$) in clean, dry, sanitary containers that should be airtight if possible. This helps in keeping food for longer duration and reduces the risk of further bacterial contamination. It is

important that the public is made aware about the importance of temperature control in case of refrigerator, storages practices and following regular efficient cleaning regimes so that effective management and cleaning of domestic refrigerators, so as to reduce the incidence of occurrence of food borne diseases among the consumers. However, in the majority of cases, effective cooking and proper storage will eliminate or reduce pathogens in domestic food production and service. Thus, it is quite essential to include effective cooking at the proper temperature and proper storage of food commodities as an important safety measure in consumer education and awareness programmes [8]. Thus, the aim of the present study was to assess the food storage practices regarding refrigeration/refrigerated foods among consumers, to determine the storage time interval of keeping different food commodities in the refrigerator and to correlate storage practices with food borne disease incidence.

Material and Methods

A selection of 300 households was randomly done from Ludhiana district (Punjab). A pre-structured food safety questionnaire was designed involving 10 statements covering all aspects of storage practices regarding food safety on the rating scale of 5-1. The respondents were asked to rate the statements on the basis of extent of their agreement from "Strongly Agree" (score given was 5) to "Strongly Disagree" (score given was 1) respectively. In order to investigate the storage time of different commodities in the refrigerator, the respondents were asked to responds on different time durations used for storing the food commodities ranging from "less than 4 hours" to period of "1 week". The questionnaire was pretested by undertaking a pilot study involving 10 urban households from locality to ensure the validity of questionnaire. On the basis of the feedback received, the questionnaire was finalized by incorporating the changes and this sample size was excluded from the final sample.

Statistical Analysis

The findings were analyzed with respect to the household respondents of Ludhiana district. The data was analyzed with SPSS Software (Statistical Package for Social Science version 16.00). Mean, percentage and standard deviation were calculated and presented in the tabular form. Independent t- test and one way ANOVA were used to evaluate the significant difference ($p<0.05$) and Tukey-HSD among respondents pertaining to the food storage practices. In addition, in terms of correlation between disease incidence and storages practices, Pearson correlation coefficient were used in the evaluation of overall food storages practices regarding food safety.

Results and Discussion

The mean scores of storage practices of the respondents in relation to food safety are presented in **Table 1**. From the table it was observed that the respondents agreed to the statement that "discarding anything left out for too long" with the highest mean score of 4.89. The respondents showed agreement that "food must be stored in areas designed for food storage including pantries, refrigerators and freezers" with second highest mean score of 4.89. Respondents also showed agreement on the fact that "fruits and vegetables should be placed at the lower most cabinet/ drawer of the refrigerator" as the mean score came out to be 4.84. "Keep raw foods and ready-to-eat foods separate to avoid cross-contamination". The respondents agreed with this statement with a mean score of 4.78. The respondents also agreed to the statement to "cover food with tight fitting lids, foil or plastic film while refrigerating" with the mean score of 4.73. "Raw foods should be placed below the shelves under cooked foods". The respondents were agreeing with this statement with the mean score of 4.70. The respondents were asked to give the extent of their agreement to the statement "milk and milk products should be kept on the first top most rack just under the freezer cabinet". The respondents agreed and gave the mean score of 4.54. The respondents also understood that "attention should be given to the raw foods stored separately". This statement was given a mean score of 4.47. "High risked products like fish, poultry, meat and meat products should be kept under freezer cabinet of the refrigerator". The respondents agreed with this statement with a mean score of 4.24. The respondents also agreed again to the fact that food in opened cans should not be stored with a mean score of 3.22.

From the available results, it can be stated that all the respondents were having good storage practices regarding food safety as they knew the importance of covering and storing of food in specific places- pantries, refrigerators and freezers, saving food from cross –contamination as the mean score was found to be higher than the midpoint of the scale i.e.3. Results also indicated that cleanliness of kitchens area and other surfaces and discarding food kept for long hours were given more importance.

Table 1 Food storage practices of respondents in relation to food safety

S. No.	Statements	Mean ±SD (N= 300)	Z value (p-value)
1	Food must be stored in areas designed for food storage including pantries, refrigerators and freezers.	4.89±0.33	97.99**(<0.0001)
2	Keep raw foods and ready-to-eat foods separate to avoid cross-contamination.	4.78±0.49	63.42**(<0.0001)
3	Raw foods should be stored separately especially pieces of meats and meat products from falling on cooked foods.	4.47±0.92	27.69**(<0.0001)
4	Raw foods should be placed below the shelves under cooked foods.	4.70±0.59	50.37**(<0.0001)
5	Keep the milk and milk products on the first top most rack just under the freezer cabinet.	4.54±0.62	43.48**(<0.0001)
6	High risked products like fish, poultry, meat and meat products should be kept under freezer cabinet of the refrigerator.	4.24±1.19	17.97**(<0.0001)
7	Fruits and vegetables should be placed at the lower most cabinet / drawer of the refrigerator.	4.84±0.37	86.79**(<0.0001)
8	Food in opened cans should not be stored.	3.22±1.65	2.31*(<0.02)
9	Cover food with tight fitting lids, foil or plastic film while refrigerating.	4.73±0.62	48.06**(<0.0001)
10	Discard anything left out too long.	4.89±0.35	94.94**(<0.0001)

Mean compared against midpoint of the scale i.e. 3
**Significant at 1% level, *significant at 5% level

Refrigerator storage is one of the most widely practiced methods of controlling microbial growth in perishable foods items. There are numbers of studies which reported the growth of microbes and incidence of food borne disease occur due to improper storage practices of foods regarding refrigeration food safety. Langiano [9] reported that 40.9 percent of the food was generally stored in sealed containers in the refrigerator and 39.4 percent in free spaces. Direct contact between cooked and raw foods was only avoided were 36.5 percent indicating the respondents were unaware of the risk caused due to cross contamination. Similarly, Egan [10] reported that food borne diseases have been associated with improper storage or reheating, food stored inappropriately and cross contamination. A study concluded that the ratio of people knowing the requirement to separate raw food from cooked ones to those not knowing is 84.6 percent [11].

Abuga [12] studied the food hygiene and safety practices among households in Langata Sub-County, Nairobi County and reported an average (42.9%) food hygiene and safety practices among the respondents. Majority of the consumers in Langata who carried out unsafe food handling practices despite having high knowledge in safe food handling practices.

Additionally the storage practices of the respondents in relation to food safety were also studied on the basis of gender (**Table 2**). The overall results showed that female respondents had better storage practices towards food safety regarding storage of foods at specific places like pantries, refrigerators and freezers with a mean score of 4.91; keeping raw food separate to avoid cross contamination(mean score- 4.81); regarding placing of raw foods below the shelves under cooked foods (mean score- 4.72); keeping milk and milk products on top most rack of freezer cabinet (mean score- 4.55) and fruit and vegetables should be placed at lower most drawer of the refrigerator(mean score- 4.85) were found to be non-significantly different as compared to male respondents. A study by Jevsnik [13] reported that gender, age, level of education and marital status were not factors influencing good food hygiene and safety practices. On the contrary, it has been demonstrated that level of education affects the level of knowledge or awareness pertaining to food hygienic practices in the consumers [14].

Storing practices of respondents in relation to food safety was also determined on the basis of the family type (**Table 3**). Overall results revealed that the nuclear families had better storage practices towards food safety. Nuclear families gave priorities to the following statements which are considered important were food must be stored in areas including pantries, refrigerators and freezers with a mean score of 4.93; keeping raw foods and ready to eat foods separate to avoid cross contamination (mean score- 4.84); food should be discarded if kept for too long(mean score- 4.92); fruits and vegetables should be placed at lower most cabinet of refrigerator (mean score- 4.79) and raw foods should be placed below the shelves under cooked foods (mean score- 4.74). Unusan [15] investigated the consumer food safety knowledge and practices in Turkey and found that there was no statistical significance of demographic

profile on food storing practices. A study conducted by Gunsam [16] reported that among Mauritius consumers, 51.3% of consumers were having fairly good food hygiene and safety practices. Redmond [17] reported that consumers who had unsafe food handling and storing practices had to suffer from food poisoning.

Table 2 Food storing practices of respondents in relation to food safety on the basis of gender

S. No.	Statements	Mean ± SD		Z value (p- value)
		Male (n= 79)	Female (n=221)	
1	Food must be stored in areas designed for food storage including pantries, refrigerators and freezers.	4.85±0.39	4.91±0.31	1.30 (0.19)
2	Keep raw foods and ready-to-eat foods separate to avoid cross-contamination.	4.71±0.53	4.81±0.47	1.59 (0.11)
3	Raw foods should be stored separately especially pieces of meats and meat products from falling on cooked foods.	4.33±0.92	4.52±0.92	1.59 (0.11)
4	Raw foods should be placed below the shelves under cooked foods.	4.66±0.53	4.72±0.61	0.79 (0.43)
5	Keep the milk and milk products on the first top most rack just under the freezer cabinet.	4.52±0.57	4.55±0.63	0.35 (0.72)
6	High risked products like fish, poultry, meat and meat products should be kept under freezer cabinet of the refrigerator.	4.23±1.23	4.25±1.19	0.13 (0.89)
7	Fruits and vegetables should be placed at the lower most cabinet /drawer of the refrigerator.	4.82±0.38	4.85±0.36	0.49 (0.63)
8	Food in opened cans should not be stored.	3.25±1.57	3.21±0.63	0.21 (0.84)
9	Cover food with tight fitting lids, foil or plastic film while refrigerating.	4.87±0.33	4.68±0.69	2.34* (0.02)
10	Discard anything left out too long.	4.95±0.22	4.88±0.38	1.58 (0.12)

Mean compared against midpoint of the scale i.e. 3
**Significant at 1% level, *significant at 5% level

Table 3 Food storing practices of respondents in relation to food safety on the basis of family type

S. No.	Statements	Mean ± SD		Z value (p-value)
		Joint (n= 99)	Nuclear (n= 201)	
1	Food must be stored in areas designed for food storage including pantries, refrigerators and freezers.	4.79±0.45	4.93±0.24	3.41**(0.001)
2	Keep raw foods and ready-to-eat foods separate to avoid cross-contamination.	4.67±0.55	4.84±0.44	2.95**(0.003)
3	Raw foods should be stored separately especially pieces of meats and meat products from falling on cooked foods.	4.40±0.95	4.50±0.90	0.87(0.39)
4	Raw foods should be placed below the shelves under cooked foods.	4.62±0.71	4.74±0.51	1.82(0.07)
5	Keep the milk and milk products on the first top most rack just under the freezer cabinet.	4.52±0.67	4.54±0.58	0.29(0.77)
6	High risked products like fish, poultry, meat and meat products should be kept under freezer cabinet of the refrigerator.	4.16±1.26	4.28±1.16	0.83(0.41)
7	Fruits and vegetables should be placed at the lower most cabinet /drawer of the refrigerator.	4.92±0.25	4.79±0.40	2.99**(0.003)
8	Food in opened cans should not be stored.	4.92±0.26	3.58±1.53	2.72**(0.007)
9	Cover food with tight fitting lids, foil or plastic film while refrigerating.	4.82±0.43	4.69±0.69	1.66(9.47)
10	Discard anything left out too long.	4.85±0.44	4.92±0.28	1.69(11.62)

Mean compared against midpoint of the scale i.e. 3
**Significant at 1% level, *significant at 5% level

According to Kangan [18] for ensuring food safety in the home it is important that food is handled and stored properly. Unfortunately there are a number of factors related to the onset of food borne illnesses due to inappropriate food safety practices. Under cooking of food, improper food storage and cross-contamination were the risk factors for

domestic outbreaks of food borne pathogens which may be responsible for 30% of all salmonella outbreaks in the home.

Worsfold [19] reported poor food handling practices among 108 consumers that could be seen during all stages: purchasing, preparation of food, cooking and storage of food. Such practices may lead to the great danger of cross-contamination and subsequent food poisoning/illnesses. It has been estimated that 66% of consumers do not wash their hands before work, 41% do not wash vegetables, and 60% use a single board for all cutting tasks.

Food safety regarding storage practices of respondents were also studied on the basis of the occupation of respondents (**Table 4**). The overall results revealed that respondents of service class respondents had better storage practices towards food safety regarding following statements- Discard anything left out for too long with a mean score of 4.93; food must be stored in areas including pantries, refrigerators and freezers (mean score- 4.92); keep raw foods and ready to eat food separate to avoid cross contamination (mean score- 4.79) and raw foods should be placed below the shelves under cooked foods (mean score- 4.73) which was found to be non-significantly different as compared to business class respondents.

Table 4 Food storing practices of respondents in relation to food safety on the basis of occupation

S. No	Statements	Mean ± SD		Z value (p- value)
		Business (n= 163)	Service (n= 135)	
1	Food must be stored in areas designed for food storage including pantries, refrigerators and freezers.	4.87±0.37	4.92±0.53	1.23(0.22)
2	Keep raw foods and ready-to-eat foods separate to avoid cross-contamination.	4.78±0.44	4.79±0.98	0.23(0.81)
3	Raw foods should be stored separately especially pieces of meats and meat products from falling on cooked foods.	4.46±0.88	4.48±0.61	0.19(0.84)
4	Raw foods should be placed below the shelves under cooked foods.	4.68±0.56	4.73±1.18	0.77(0.44)
5	Keep the milk and milk products on the first top most rack just under the freezer cabinet.	4.60±0.61	4.47±0.41	1.89(0.06)
6	High risked products like fish, poultry, meat and meat products should be kept under freezer cabinet of the refrigerator.	4.17±1.21	4.33±1.72	1.20(0.23)
7	Fruits and vegetables should be placed at the lower most cabinet /drawer of the refrigerator.	4.89±0.31	4.78±0.71	2.81**(0.005)
8	Food in opened cans should not be stored.	3.33±1.59	3.07±1.72	1.38(0.17)
9	Cover food with tight fitting lids, foil or plastic film while refrigerating.	4.78±0.54	4.68±0.71	1.34(0.09)
10	Discard anything left out too long.	4.88±0.38	4.93±0.28	1.22(0.09)

Mean compared against midpoint of the scale i.e. 3
**Significant at 1% level, *significant at 5% level

Food storage practices of the respondents in relation to food safety were studied on the basis of the educational qualification of the respondents presented in **Table 5**. Data showed that educational qualification of the respondents did not affect the adoption of good food storing practices. As it can be seen from the results that the respondents with lower education qualification (12^{th} standard and graduates) were having better food storing practices as compared to the higher education qualification (post graduates). It can be seen from the table that respondents upto class 12^{th} and graduates agreed with the statement that "keeping the milk and milk products on the first top most rack just under the freezer cabinet" with a mean score of (4.56) as compared to postgraduates. The 12^{th} class respondents from the household also showed better food storing practices and agreed with respect to following statements that "fruits and vegetables should be placed at the lower most cabinet /drawer of the refrigerator" with mean score (4.90) and "anything left out too long should be discarded" (4.92) but were non-significantly different as compared to post graduates and graduates respondents. The statement "food in opened cans should not be stored" had a mean score of 3.90 was given respondents of 12^{th} standard which was significantly ($p<0.01$) higher when compared to the other categories. "Raw foods should be stored separately" with a higher scores (4.61) were given by the graduates respondents showed significant difference ($p<0.01$) in the mean scores was given by the three categories. Graduates were more aware about the "high risked products like fish, poultry, meat and meat products that should be kept under freezer cabinet of the refrigerator" showed agreement to the statement with a high mean score of 4.43 which was significantly different ($p<0.05$) when compared to post graduates and 12^{th} class respondents.

Table 5 Food storing practices of respondents in relation to food safety on basis of educational qualification

S. No.	Statement	Category	Mean ± SD	F-value (p-value)
1	Food must be stored in areas designed for food storage including pantries, refrigerators and freezers.	Upto 12th standard	4.75[b]±0.52	5.74**
		Graduation	4.91[a]±0.281	(0.004)
		Post – graduation	4.92[a]±0.26	
2	Keep raw foods and ready-to-eat foods separate to avoid cross-contamination.	Upto 12th standard	4.58[b]±0.64	6.11**
		Graduation	4.81[a]±0.41	(0.003)
		Post – graduation	4.85[a]±0.47	
3	Raw foods should be stored separately especially pieces of meats and meat products from falling on cooked foods	Upto 12th standard	4.17[b]±1.08	4.45*
		Graduation	4.61[a]±0.72	(0.013)
		Post – graduation	4.43[ab]±1.03	
4	Raw foods should be placed below the shelves under cooked foods.	Upto 12th standard	4.48[b]±0.89	4.75**
		Graduation	4.74[a]±0.50	(0.009)
		Post – graduation	4.77[a]±0.47	
5	Keep the milk and milk products on the first top most rack just under the freezer cabinet.	Upto 12th standard	4.56[a]±0.78	0.36
		Graduation	4.56[a]±0.54	(0.698)
		Post – graduation	4.50[a]±0.62	
6	High risked products like fish, poultry, meat and meat products should be kept under freezer cabinet of the refrigerator	Upto 12th standard	3.98[b]±1.32	3.46*
		Graduation	4.43[a]±1.01	(0.033)
		Post – graduation	4.13[ab]±1.33	
7	Fruits and vegetables should be placed at the lower most cabinet /drawer of the refrigerator.	Upto 12th standard	4.90[a]±0.29	0.96
		Graduation	4.83[a]±0.38	(0.386)
		Post – graduation	4.82[a]±0.38	
8	Food in opened cans should not be stored.	Upto 12th standard	3.90[a]±1.51	6.62**
		Graduation	3.21[b]±1.59	(0.002)
		Post – graduation	2.91[b]±1.71	
9	Cover food with tight fitting lids, foil or plastic film while refrigerating.	Upto 12th standard	4.71[a]±0.69	0.15
		Graduation	4.72[a]±0.68	(0.861)
		Post – graduation	4.76[a]±0.51	
10	Discard anything left out too long.	Upto 12th standard	4.92[a]±0.27	0.29
		Graduation	4.90[a]±0.30	(0.750)
		Post – graduation	4.88[a]±0.43	

Mean compared against midpoint of the scale i.e. 3
Tukey HSD ($p<0.05$): means with different superscripts are significantly different
**Significant at 1% level, *significant at 5% level

A significantly ($p<0.01$) higher mean scores given by the post graduate respondents to the practices: "food must be stored in areas designed for food storage including pantries, refrigerators and freezers" (4.92), "keep raw foods and ready-to-eat foods separate to avoid cross-contamination" (4.85) and "raw foods should be placed below the shelves under cooked foods" (4.77). Also higher mean score of 4.76 was given by the postgraduates to the statement that "covering food with tight fitting lids, foil or plastic film while refrigerating" was important as compared to other categories.

The refrigeration with low temperature (≤ 5°C) that reduces the microbial growth in the food commodities thus increasing their self-life. There is a general perception among the masses to cook food in bulk and store in the refrigerator for a longer duration of time which was considered safe enough for consumption. In order to investigate the storage time of different commodities in the refrigerator, the respondents were asked to responds on different time durations used for storing the food commodities ranging from less than 4 hours to period of 1 week. The results are represented in the **Table 6**. It was seen from the table that majority of the food commodities were stored in the refrigerator for 4-12 hours. These commodities includes- dough (89%), cooked rice, pulav/ khichdi (85%), cooked pulses(84)%, cooked / boiled vegetables(77%), milk and milk products (82%) and cooked gravy / canned products(58.3%). This was followed by storing the food commodities for less than 4 hours. In this category food items like raw meat and meat products, poultry, raw fish (64.7%), cooked chicken, fish, meat and boiled eggs (63.3%), raw eggs (52%) and salads (93.7%) were included. Raw fruits (68.7%) and vegetables (64%) were stored in a refrigerated condition for the period of 2-3 days and most of the processed and the frozen foods like butter / mayonnaise (84.3%), jam jellies(84.3%) ketchups(92.7%), squashes(94%), soy sauce and vinegar (90.3%), ice creams, cold drinks (47.7%) and frozen peas/ products (84.3%) were stored in the refrigerated condition for 1 week. Sun [20] reported that steak, mince and salmon were acceptable (microbially) for 8, 8, and 4 days, respectively, in the

refrigerators operating at -2.0, -0.1, 1.5, or 1.7 °C. While the shelf-life of all of the foods was extended to 10 days in the refrigerator operating at – 4.8 °C. Beumer [21] summarized the findings concerning the microbiological quality of leftovers which concluded that leftovers should be handled with utmost care, kept in clean trays, stored in cool environment (4-7°C) as quickly as possible, and not stored for longer than three days. The lack of hygiene in over half of sampled domestic refrigerators is a risk for contracting a food borne illness among the population of Guadalajara, Jalisco, Mexico. Also if fruits and vegetables, meats, poultry, and eggs are stored in the refrigerator without washing or cleaning, promotes cross contamination inside the refrigerator. It is well known that storage of raw and cooked foods represents a risk of pathogen contamination of foods. For this reason, it has been recommended to store both type of foods separately in adequate covered containers [22]. Many of the sampled refrigerators contained inadequately stored products such as food in cans, on plates, and/or in pots and pans, often uncovered. This lack of organization could be the major cause of cross contamination [23].

Table 6 Storage time of different food commodities in the refrigerator

Types of foods	**Less than 4 hours**	**4-12 hours**	**12-24 hours**	**2-3 days**	**One week**
Dough	23(7.7)	268(89.3)	6(2.0)	3(1.0)	-
Cooked rice, *Pulao / khichdi*	30(10)	256(85.3)	11(3.7)	-	3(1)
Cooked pulses/ *dhals*	32(10.70)	252(84)	12(4)	1(.3)	3(1.0)
Fruits	9(3)	27(9)	9(3)	206(68.7)	49(16.3)
Vegetables	12(4)	20(6.7)	14(4.7)	192(64)	62(20.7)
Cooked/ boiled vegetables	24(8)	231(77)	23(7.7)	15(5)	7(2.3)
Milk and milk products	10(3.3)	246(82)	37(12.3)	7(2.3)	-
Raw meat and meat products and poultry, raw fish	194(64.7)	88(29.3)	12(4)	2(0.7)	4(1.3)
Cooked chicken, fish, meat and boiled eggs	190(63.3)	94(31.3)	10(3.3)	2(0.7)	4(1.3)
Raw eggs	156(52)	30(10)	2(0.7)	33(11.0)	79(26.3)
Salads	281(93.7)	15(5)	-	1(0.3)	3(1.0)
Butter / mayonnaise	10(3.3)	3(1)	3(1)	31(10.3)	253(84.3)
Cooked gravy, canned products	76(25.3)	175(58.3)	20(6.7)	6(2.0)	23(7.7)
Frozen peas / products	39(13)	2(0.7)	1(0.3)	5(1.7)	253(84.3)
Dry fruits	132(44)	2(0.7)	1(0.3)	6(2)	159(53)
Ice creams, cold drinks	96(32)	30(10)	9(3)	22(7.3)	143(47.7)
Jam/ jellies	46(15.3)	-	-	1(0.3)	253(84.3)
Ketchups	22(7.3)	-	-	-	278(92.7)
Squashes	16(5.3)	-	-	2(0.7)	282(94)
Soy sauce, vinegar	29(9.7)	-	-	-	271(90.3)

Values in the parenthesis are percentages

According to FSA [24] consumers are often told where to store the food in the refrigerator. In U.K.it is recommended that perishable foods should be stored at the top and middle shelve and ready-to-eat foods "such as dairy products, yogurts, cream, cream cakes, butter/margarine, cooked meats, leftovers-covered, and other packaged foods. The bottom shelve should be used for storing raw meat, poultry and fish. All the salad vegetables, fruits, and vegetables should be kept in the salad drawer.

According to Marklinder [25] the percentage of respondents who tried to find the coldest location was 33% for minced meat, 2% for soft cheese, 23% for milk, 14% for ham, 17% for salmon, and 3% for RTE salad. A large proportion of the respondents who tried to store food in the coldest location put the food on the top shelf of their refrigerator (e.g., minced meat 58%, herring 44%, and milk 70%). In contrast with the study Li-Cohen [26] reported that 23% of their respondents just stored meat, poultry or fish where ever they found a place in their refrigerator in respective of the shelf preferred.

Consumers can cause food borne illnesses due to poor personal practices, lack of hand washing, poor cleanliness of refrigerators, and lack of proper storage during refrigeration Smyth [4]. It is recommended that raw meat, poultry, and fish should be stored separately from other ready-to-eat foods in the refrigerator in order to avoid any cross contamination [27].

Some potential for temperature abuse exists because 7% of respondents allow more than 90 min to lapse between shopping and chilled or frozen storage. Any practice in which food is held over time in temperatures conductive to bacterial growth is a potential risk in terms of food safety because it allows more rapid growth of spoilage microorganisms and the growth of food pathogens, if they are present [28].One method of helping to ensure that perishable food remains microbiologically safe after purchase is to place it in a refrigerator or freezer as soon as

possible. In a study conducted if food is held over time in temperatures conductive to bacterial growth, there is a potential risk in terms of food safety because it allows more rapid growth of spoilage microorganisms and the growth of food pathogens, if they are present. This is important at the domestic refrigeration stage, which can be the last line of defense in terms of controlling bacterial proliferation

Overall correlation result of disease incidence with food safety storage practices

Good refrigeration storage practices were negatively correlated (r = -0.10) with the incidence of food borne diseases thus indicating that the respondents who were following better food safety storage practices were having quite low chances of incidence of food borne diseases. The incidence of food borne disease in comparison with the storage practices pertaining to food safety was assessed. The below average mean score of disease incidence was 4.57 and the above mean score found to be 4.50 in relation with food storage practices. Thus indicating that the respondents with better refrigeration storage practices regarding food safety, were having low incidence of food borne diseases.

Conclusion

The study concluded that all the respondents of Ludhiana district were having good storage practices pertaining to food safety issues as the mean score was found above the mid value of 3. Good storage practices in relation to food safety were negatively correlated with the incidence of food borne diseases thus indicating that the respondents who were following better food safety storage practices were having quite low chances of incidence of food borne diseases. Therefore there is pertinent need to spread knowledge and awareness among households' members regarding refrigerated foods and food safety practices such as proper storing of perishable and frozen foods at appropriate time and temperature in order to reduce the risk of bacterial contamination.

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Publication History
Received 16.02.2021
Revised 21.05.2021
Accepted 22.05.2021
Online 25.05.2021