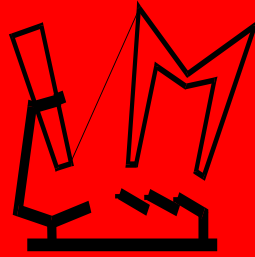


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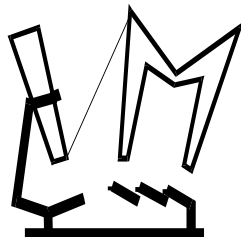
INTERNATIONAL
57th MEAT INDUSTRY CONFERENCE

**MEAT AND MEAT PRODUCTS – PERSPECTIVES OF
SUSTAINABLE PRODUCTION**

Belgrade, June 10th-12th, 2013

ISBN 978-86-82547-07-5

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EXAMINATION ABOUT CONSUMERS' KNOWLEDGE OF FOOD STORAGE CONDITIONS IN HOUSEHOLD - CONTEXT OF FOOD SAFETY

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Abstract - Today, food safety and quality have a significant role in consumer health, as final link in the food chain. Legislation clearly defines temperature conditions during the production, distribution and retailing of chilled food. As soon as the consumer purchases the food, it is outside of any of these legislative requirements. Inadequate temperature in domestic refrigeration is frequently cited as possible factor in food poisoning incidents. In this study applied to a representative sample of households (n=100) throughout the City of Belgrade, the basic data were collected about conditions of food storage and preservation. Also consumer knowledge about food storage temperatures in domestic refrigerators were examined. Measuring the refrigeration temperature it was found that 92% of examined refrigerators operate at temperatures above the recommended 4°C.

Key words – food storage, refrigerators, households.

I. INTRODUCTION

The value of modern approach to food safety is reflected in the fact that it is applicable to all segments of its production. However, no matter how system was good, functional, controlled and checked, the absolute food safety cannot be ensured and guaranteed. In classical food chain strategy all relevant activities are taken for the benefit of the human being but, locating them outside the system as a consumer [16]. After a chilled product is removed from a retail display cabinet it's outside a refrigerated environment whilst it is carried around the store and then transported home for further storage. This time from shopping to prepare is the time when

practical stops food safety control. If the customer is excluded from the food safety chain, it can't be considered the principle of food safety "from farm to fork" [19, 21]. Good housekeeping practice is according to a considerable number of food borne diseases occurring in domestic food preparation, still neglected. Most consumers are unaware that at least 60% of food borne illness is caused by cooking at home [4].

Factors involved in food borne diseases are numerous and various, from those related to contamination (cross-contamination, improper storage), through factors important to survival of microorganisms (improper storage time/temperature), to those related to the microbial growth that can contribute to outbreaks and other factors, mostly of unknown source [15]. Good housekeeping practice represents all hygiene principles and techniques from purchase to home food preparation and consumption of home prepared food. The most common issues that occur and impact on food safety are wrong and settled personal habits.

Temperature is one of the major controlling factors of food quality and safety because of its influence on microbial growth rates. This is reflected in the extensive use of cold storage as a means to minimize micro-biological growth in food. One of the critical factors for food safety storage is the refrigerator temperature. Any practice in which food is held over time in temperatures conducive 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 [9]. Microbial growth can occur

at all stages in the farm to table continuum, and knowledge of the temperature profile along the food chain is important in order to assess and manage risks associated with microbial hazards [11]. One helping method to ensure that perishable food remains microbiologically safe after purchase is to place it in a refrigerator or freezer as soon as possible. However, data on consumer handling practices, in particular refrigeration temperatures and storage times, are scarce [2, 7, 17]. In addition, storage temperatures can vary with geographic location. For instance, Nauta et al [12] indicate that the temperatures measured in refrigerators of northern lands of Europe were generally lower than temperatures measured in refrigerators of countries that were located southwards, on the basis of data from a few European countries. This lack of data on consumer storage temperatures is a limiting factor when trying to estimate exposure in risk assessments covering the consumer stage.

There has been significant concern in recent years over the role of inadequate temperature control and handling in the home on the number of food poisoning incidents. It is clear from the many published surveys that many refrigerators throughout the world are running at higher than recommended temperatures [7]. Recommendations in the UK concerning the microbiological safety of foods advise that maximum temperatures in domestic refrigerators should not exceed 5°C [18]. Many surveys confirm the effect of basic food hygiene knowledge on hygienic practice and identifies specific areas for emphasis in the development and delivery of effective food safety risk communication messages to consumers. Safety measures conducted by consumers in their homes have a key role in the prevention of food borne illnesses, because they make the final step in the process of preparing food. Safe food handling in households considered to be “last line of defense by consumers” [15]. Perhaps even more remarkable is that despite numerous recommendations on handling and storage temperatures, consumer use and the performance of refrigerators remain remarkably unchanged throughout the world over the last 30 years [7]. Recommended storage temperature for

some food items are presented in Table 1 (“Sl. glasnik RS”, no 31/2012).

Table 1 Recommended storage temperature for some food items

Recommended storage temperature (°C)	Group	Food item
0-2	I	Chopped wrapped meat
0-3	II	Food packed into a modified atmosphere packing (MAP)
0-4	III	Semi products of meat, smoked products, cooked pasteurized sausages, cold meat meals, pasteurized cans, bacon, pasteurized milk, cream, butter
0-7	IV	Lard and cracklings
0-10	V	Fermented spreadable sausages, smoked meat slices, cooked sausage, cooked cans, dried bacon, yogurt, cheese
0-13	VI	Eggs

The aim of this study was to investigate the conditions of food keeping in households (storage conditions, consumer knowledge, and refrigerator temperatures).

II. MATERIALS AND METHODS

Materials

This study includes 100 households from the Belgrade area. Data was collected with consent of family members and was based on the voluntariness of consumers to participate in this research.

Methods

For this study a standardized questionnaire was used in the form of an interview and applied in the homes of respondents, immediately after their consent to participate in research. All obtained answers and collected data were anonymous. The survey is related to collecting general data referring to conditions of food

storage by consumers and temperatures in their refrigerators

Mini data logger, model Testo 174H (ISO 14644-3:2005) adjusted to record the internal refrigerator temperature measured simultaneously in three different places. Testo 174H temperature data loggers were adapted to measure the internal temperature of the refrigerator (center of top and bottom shelf and the middle shelf of refrigerator door) every minute for 30 minutes.

Statistical analysis of the results was elaborated using software GrapfPad Prism 5.00. All parameters were represented by descriptive statistical parameters (mean, standard deviation, minimum and maximum value). Student t-test was used to examine differences between recommended and examined temperatures, while ANOVA was used for testing differences among temperatures measured at three places in refrigerator.

III. RESULTS AND DISCUSSION

Consumer knowledge of food storage temperatures in refrigerators are shown in Figure 1. More than half of householders interviewed (56%) were aware of the recommended storage temperature, while 26% of respondents were unsure. Also, 18% of respondents did not know the correct temperature for refrigeration. Storage temperatures were generally higher than recommended (in 94% refrigerators temperature was over 4°C), even at consumers who knew the recommended refrigerator temperature.

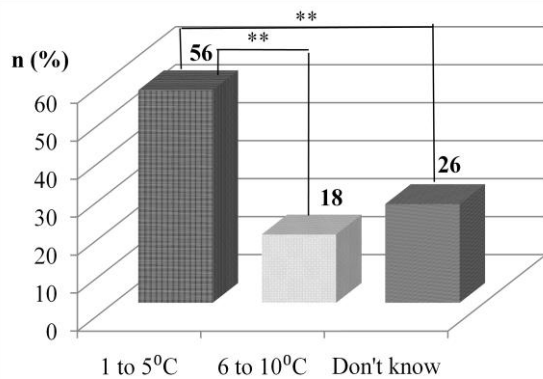


Figure 1 Consumer knowledge about storage conditions

Legend: ** - p<0.01

Of the 100 surveyed refrigerator temperatures, the lowest recorded temperature on the top shelf of refrigerators was -1.9°C, while the maximum temperature was 20.8°C (average 8.95±3.64°C). On the bottom shelf of refrigerators the lowest measured temperature was 0.1°C and the highest 21.4°C (average 8.61±3.36°C). The fridge door had significantly higher temperatures (p<0,01) compared to the inside of refrigerators. Consequently, the lowest re-corded temperature in refrigerator door was 2.4°C and the highest 21.8°C (average 10.43±3.28°C) (Figure 2). It was found that the average temperature in the refrigerator door were statistically higher (p<0.01) than the average temperature on the bottom shelf and also significantly higher (p<0.05) than the average temperature on the top shelf and total average temperature. The maximum measured average temperature of one refrigerator was 21.33°C, and a minimum 1.37°C (average 9,33±3,51°C). In 92% refrigerators the average temperature was above 5°C.

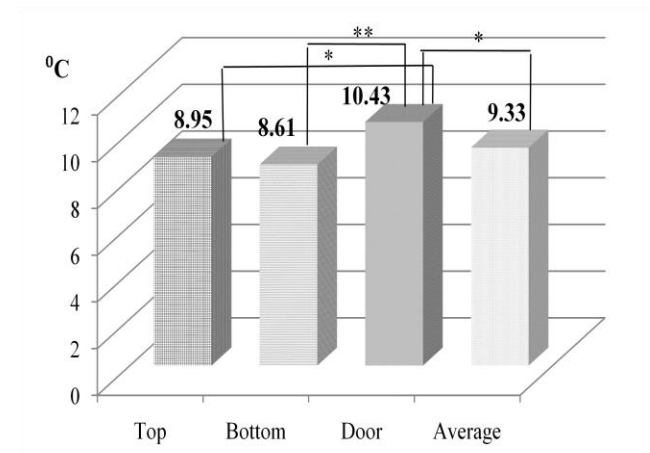


Figure 2 Average refrigerator temperature of three different places

Legend: * - p<0.05; ** - p<0.01;

Average measured temperature in refrigerators were significantly higher (p<0,01) then recommended storage temperature of certain food groups (I, II, III, IV, VI), but not statistically different than food items in group V (Table 2).

Table 2 The average measured temperature and recommended storage temperature of certain food groups (food items from Table 1)

Average measured temperature (°C)	Recommended storage temperature of certain food groups (°C)					
	I	II	III	IV	V	VI
9,33 ^{A,B,C,D,E}	2 ^A	3 ^B	4 ^C	7 ^D	10	13 ^E

In our study more than half of consumers (55%) knew the recommended storage temperature in refrigerator. There appears to be deference in awareness of recommended refrigerator temperature settings between countries. In an Australian telephone survey [8] only 15.5% of respondents knew the temperature of their fridge. A Swedish survey [11] found a good level of awareness amongst its survey group, with 85% of respondents knowing the recommended refrigeration temperature (in this case 8 °C).

However, not all of those consumers put their knowledge into a practice. The survey found 40% of food storage temperatures exceeded the maximum recommended temperature for the food being stored. Also only 25% knew, or regularly measured, the temperature of their refrigerator. A later Irish study found that only 22% of consumers were aware of the correct temperature to operate their refrigerator [9] and 23.2% had a refrigerator thermometer. This can be compared with the results of survey in the UK, SAD and Australia, where 10%, 54% and 32.3%, respectively of consumers know the exact temperature of refrigerator [1, 8, 17]. Ghebrehewet and Stevenson [5] found that after home-based hygiene training the proportion of consumers that were aware of correct operating temperatures rose from 31.7% to 78.4%. In this survey 94% of refrigerators were found to operate, on average, at temperatures above the recommended, even at consumers who knew the recommended refrigerator temperature. The lowest average temperature was 8.61°C recorded on the bottom shelf, and the average temperature on top shelf was approximately the same (8.95°C). The highest average temperature was measured in the refrigerator door (10,43°C). The

average refrigerator temperature was 9.33°C. Terpstra et al. [20] measured the temperature in the door of refrigerators. The temperatures measured ranged from 3.8 to 11.5°C which is much lower measured temperature than in our study. In analysing the data from most of the various surveys reported over the last 30 years Peck et al. [13] concluded that 61.2% of refrigerators throughout the world run at temperatures above 5°C. A reviews of all European studies showed that overall the average air temperature in European fridges would appear to be 6.64°C [12]. Since that review, further surveys have been carried out around the world, again with similar results. A survey of New Zealand Food Safety Authority survey [3], carried out by the Institute of Environmental Science and Research (ERS), found a third of the 53 refrigerators surveyed operating above the recommended temperature range of between 1 and 5°C. Refrigerator temperatures from 7.9 to 20.7°C were measure in Ireland by Kennedy et al. [9,10].

IV. CONCLUSION

More than a half (56%) of the 100 surveyed consumers believe that the temperature in refrigerators should be from 1 to 5°C and 18% of consumers believe that refrigerator temperature should be from 6 to 10°C. More than a quarter (26%) of consumers didn't know refrigerator temperature. The average temperature in examined refrigerators was 9.33±3.51°C. Recorded temperatures in fridge door were significantly higher than temperatures recorded on the top and bottom shelf. The total average temperature (9.33±3.51°C) was significantly higher than recommended temperature for most food items that are normally stored in refrigerators.

ACKNOWLEDGEMENTS

This research within Project TR 31 034 "Selected biological hazards to the safety/ quality of food of animal origin and the control measures from farm to consumer", was funded by the Ministry of Education, Science and

Technological Development of the Republic of Serbia.

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CIP - Каталогизација у публикацији
Народна библиотека Србије, Београд

637.5(082)

614.31:637.5(082)

664.9(082)

INTERNATIONAL Meat Industry Conference
Meat and Meat Products - Perspectives of
Sustainable Production (57 ; 2013 ; Beograd)
Proceedings [Elektronski izvor] /
International 57th Meat Industry Conference
Meat and Meat Products - Perspectives of
Sustainable Production, Belgrade, 10th-12th
June, 2013 ; [organizer] Institute of Meat
Hygiene and Technology, Belgrade ; [editors
in chief Slobodan Lilić, Vesna Đorđević]. -
Belgrade : Institute of Meat Hygiene and
Technology, 2013 (Belgrade : Institute of
Meat Hygiene and Technology). - 1 elektronski
optički disk (CD-ROM) ; 12 cm

Sistemski zahtevi: Nisu navedeni. - Nasl. sa
naslovnog ekrana. - Tiraž 200. -
Bibliografija uz svaki rad.

ISBN 978-86-82547-07-5

1. Institute of Meat Hygiene and Technology
(Beograd)

a) Месо - Зборници b) Месне прерађевине -
Зборници

COBISS.SR-ID 198874636