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AN ANALYSIS OF FIFTY-YEAR-SURVEILLANCE OF FOOD RELATED DISEASES IN TURKEY

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ABSTRACT

Occurrence rate and magnitude of food-related diseases (FRD) are of global concern causing socio-economic issues, and thus, they must be continuously monitored. The objectives of the study were to determine occurrence rate and trends of FRD in Turkey from 1960 to 2010 in parallel to increased rate of population growth. Recorded incidents of foodborne illnesses/diseases were obtained as annual reports and expressed as disease/population rate in order to determine trends of each disease. Long-term evaluations of bacillary dysentery (BD), brucellosis, gastrointestinal diarrhea (GD), meningitis infections, meningitis and central nervous system infections (MCNSI), other bacterial infections, other infections and parasite-caused diseases (OIPCD), other virus-caused infections, paratyphoid, and typhoid showed different trends in terms of occurrence rate but an overall decrease in the occurrence rates of BD, GD, OIPCD, and typhoid.

Keywords: foodborne diseases, public health, Turkey

1. INTRODUCTION

Foodborne illnesses/diseases are the major causes with high socio-economic impacts of death of infant, elderly and people with immune deficiency. Although foodborne illnesses/diseases exert significant impacts on societies, they are seriously underreported and underestimated [1-3]. However, the quantification and monitoring remain essential to efforts to understand and prevent them [2, 4, 5]. In contrast to advances in food quality and safety, efforts to establish HACCP plans and other safety precautions, many foodborne illnesses/diseases and outbreaks are reported each year in related literature [6-9]. The reasons for these illnesses/diseases can be cross-contamination, improper cooling, storage and/or handling, contaminated raw food/ingredient, and poor personal hygiene in handling of foods [10-13].

Several studies were reported to estimate occurrence rate and magnitude of foodborne illnesses/diseases in different European and North American countries [6, 9-12]. Even though foodborne illnesses are receiving public attention, not enough data are published for different countries to estimate their magnitude. In most cases, reported illnesses published in the related literature are from developed countries; however, it is also important to establish database about foodborne illnesses from developing and third world countries [10-13].

With its growing food industry in parallel to its increasing population growth, Turkey has been facing some issues with foodborne/food-related illnesses. Some of these illnesses occur in villages and towns where not adequate sanitation and proper handling exist, while some are caused by contamination in modern food production and distribution chain. The municipal authorities of environmental and public health are encouraged to report foodborne diseases to the Turkish Statistical Institute (TUIK) that releases yearly reports based on received information. However, there exist no published data on magnitude and/or occurrence of foodborne illnesses in Turkey. Therefore, the objectives of the study are to determine occurrence and magnitude of foodborne illnesses such as bacillary dysentery (BD), brucellosis, gastrointestinal diarrhea (GD), meningitis infections (MI), meningitis and central nervous system infections (MCNSI), other bacterial infections (OBI), other infections and parasite-caused diseases (OIPCD), other virus-caused infections (OVCI), paratyphoid, and typhoid; thus providing trends of each disease in parallel to population growth in Turkey from 1960 to 2010.

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2. MATERIALS AND METHODS

2.1. Data source

Individual outbreak investigations performed by local authorities, related-government ordinances, and hospitals were collected from 1960 to 2010 and issued as "Death Statistics Province and District Centers" by Turkish Statistical Institute (TUIK) (Ankara, Turkey) [14]. Population data between 1960 and 2010 were also obtained from TUIK [15].

2.2. Data processing

The data about foodborne diseases as obtained from TUIK were selected and categorized according to gender and total population. In order to determine trends of each disease, annual outbreak incidents obtained were divided into related portions of population and expressed in disease/population rate.

2.3. Statistical analysis

Best-fit least-square regression analysis was applied to time series data of foodborne diseases. Regression equations and their (adjusted) coefficient of determination [$R^2_{(adj)}$] values were reported. All the statistical analyses were conducted using Minitab 16.1 (Minitab Inc., State College, PA).

3. RESULTS AND DISCUSSION

The data analysis showed that while some disease records (BD, typhoid, OIPCD, and MI) were started from 1960, the others were started from 1975 (GD) and 1988 (MCNSI, paratyphoid, brucellosis, OBI and OVCI), respectively, in Turkey. BD was one of the most common foodborne diseases from 1960 to the 1970s with infection rate close to 25 per 1000. After the year 1970, the occurrence rate of the disease was lowered but increased between 1973 and 1976 again. From 1976 to 2010, the occurrence rate of the disease increased to 5 per 1000 for every four to five years and went down to per 1.74 per 1000 between 2008 and 2010 (Fig. 1). The occurrence rate of GD was much lower than that of BD between 1975 and 2002. Although few incidences were recorded between 1992 and 1994 as well as 1996 and 1998, the occurrence rate of GD was mostly less than 1 per 1000 by 2002 (Fig. 1).

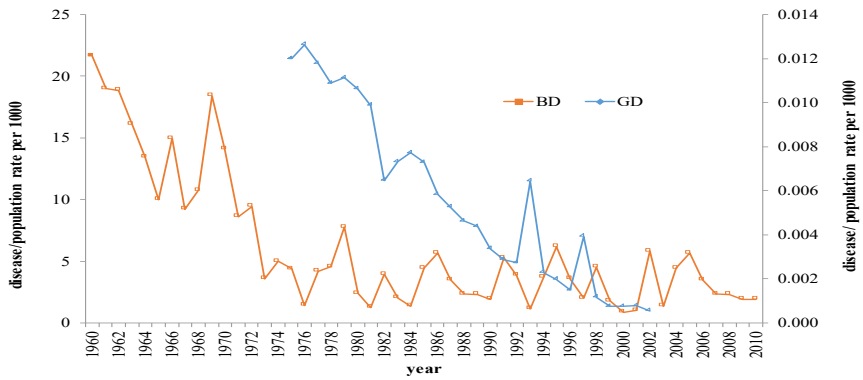

Figure 1. Occurrence rates of bacillary dysentery (BD) and gastrointestinal diarrhea (GD) in Turkey between 1960 and 2010

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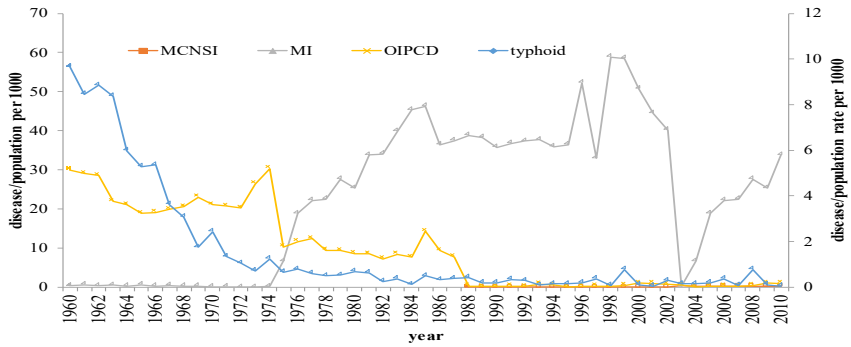

Figure 2. Occurrence rates of typhoid, other infections and parasite-caused diseases (OIPCD), meningitis infections (MI), meningitis and central nervous system infections (MCNSI), and typhoid in Turkey between 1960 and 2010

The reported cases of MI were relatively low from 1960 to 1974. From 1974 to 1985, there was a significant increase in the number of the reported cases up to 48 per 10000. However, the occurrence rate of the disease did not change between 1986 and 1995. An increase occurred in the reported cases from 1995 to 1996 up to 50 per 10000 and from 1998 to 1999 up to 58 per 10000. Starting from 2000, the number of the reported cases diminished close to zero until 2002. Unfortunately, there was another rise starting from 2002 to 2010 with 34 per 10000 (Fig. 2). Records for MCNSI were started in 1988 whose occurrence rate stayed relatively low from 1988 to 1992. In the years 1992 and 1995, the disease occurrence rate was highest with 5 per 10000. After 1996, its occurrence rate was greatly reduced; however, starting from 1996 to 2002, there was a slight increase in the outbreaks of the disease in every two to three years up to 8 per 10000 (Fig. 2).

The reported cases of OIPCD were much higher between 1960 and 1988 than over the period from 1988 to 2010. The occurrence rate of the disease was 30 per 10000 in both 1960 and 1973. Its occurrence rate was slightly reduced until 1975. The reported cases of OIPCD were highest with 13 per 10000 in 1976. After 1975, the number of reported cases, except for the increase in 1985 up to 16 per 100000, were greatly diminished and became almost zero from 1988 to 2010 (Fig. 2). The number of reported cases of typhoid started to decrease from 1960 to 1988, and did not show any significant change from 1988 to 2010. The reported cases were around 10 per 10000 in 1960 and were declined close to zero by 2010 despite a slight increase in both 1999 and 2008 (Fig. 2).

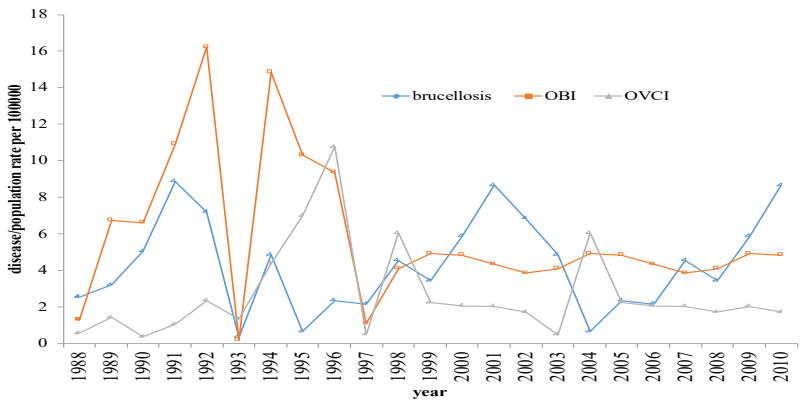

Figure 3. Occurrence rates of brucellosis, other bacterial infections (OBI), other virus-caused infections (OVCI), and paratyphoid in Turkey between 1960 and 2010

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The earliest recording of brucellosis was started in 1988. From 1988 to 1991, the occurrence rate of brucellosis increased up to 8 per 100000. In 1992, the rate was greatly diminished to zero but increased again from 1994 to 1996. Although its occurrence rate changed in every couple of years, the maximum increase was observed between 2000 and 2002 with 8 per 100000. The occurrence rate was reduced to 1 per 100000 in 2004 and gradually increased back to 8 per 100000 in 2010 (Fig. 3). The occurrence rate of OBI was also recorded after 1988 whose occurrence rate increased until 1992 with 16 per 100000. In 1993, the number of the reported cases were markedly diminished but increased back to 14 per 100000 in 1995. Despite the increase in its occurrence rate after 1997, the number of the reported cases was much lower than in 1993. Its occurrence rate was around 4 per 100000 between 1999 and 2010 (Fig. 3). The reported cases of OVCI increased up to 12 per 100000 in 1996. The reported cases decreased from 1996 to 1997 but both increased up to 7 per 100000 from 1998 to 2004. Starting from 2005, the occurrence rate was around 3 per 100000 (Fig. 3).

The reported cases of paratyphoid were started from 1988 and had an occurrence rate of 3 per 1000000, which was almost zero between 1990 and 1992. Starting from 1992, its occurrence rate rose to around 5 per 1000000 from 1994 to 2000. Its occurrence rate was diminished by 2000 but increased after 2001 to 3 per 100000 until 2006. Its occurrence rate became almost zero between 2006 and 2010 (Fig. 3).

GD was one of the most common diseases that occurred in Turkey followed by MI and OIPCD. The total numbers of GD cases were 79367 with 41446 male and 37920 female subjects. The total numbers of MI cases were 59723 with 33105 male and 26618 female subjects, whereas these numbers were 18175 with 9732 males and 8443 females for OIPCD (Tab. 1).

Table 1. Reported cases of foodborne diseases in Turkey between 1960 and 2010

Disease	Total number	Male	Female
BD	1144	624	520
Brucellosis	422	204	218
GD	79367	41446	37920
MI	59723	33105	26618
MCNSI	888	564	324
OBI	619	327	292
OIPCD	18175	9732	8443
OVCI	279	158	121
Paratyphoid	54	28	26
Typhoid	2643	1284	1359

Gender and age distributions of FRD revealed that while the occurrence rates of typhoid, BD, MI, OBI, and OVCI differed significantly ($P \leq 0.05$), no significant difference was detected for paratyphoid, and brucellosis among all the age groups (Tab. 2). It was obvious that most FRD diseases except for typhoid were reported mostly for the newborns. The higher occurrence rate of typhoid was reported for the age groups of 15-24, 5-14, and 25–34 ($P \leq 0.05$); whereas the lower occurrence rate was reported for age groups of 65-74, >75, 55-64, and 45-54, respectively. The BD cases were mostly reported for the newborns followed by the age groups of 25-34, 15-24, 35-44, and 5-14. On the other hand, the higher occurrence rate occurred for 5-14, newborns, and 1-4 ($P \leq 0.05$) (Tab. 2).

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Table 2. Male age distribution of foodborne diseases reported in Turkey between 1960 and 2010

Disease	Age group									
	<1	**1–4**	**5–14**	**15–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65–74**	**>75**
BD	4.76^{a}	2.07^{b}	0.73^{c}	0.59^{c}	0.28^{c}	0.71^{c}	0.95^{bc}	1.57^{bc}	1.83^{bc}	1.33^{bc}
Brucellosis	1.25^{a}	0.5^{a}	0.5^{a}	0.25^{a}	0.5^{a}	1.00^{a}	1.75^{a}	2.12^{a}	2.75^{a}	2.12^{a}
GD	859.9^{a}	219.3^{b}	32.9^{c}	8.4^{c}	7.7^{c}	7.2^{c}	9.4^{c}	13.9^{c}	22.5^{c}	33.3^{c}
MI	509.5^{a}	100.4^{b}	32.9^{b}	17.0^{b}	14.4^{b}	16.9^{b}	23.7^{b}	28.9^{b}	30.8^{b}	19.2^{b}
MCNSI	2.37^{a}	3.75^{a}	1.62^{a}	1.5^{a}	2.25^{a}	1.12^{a}	2.00^{a}	2.37^{a}	2.00^{a}	1.62^{a}
OBI	11.75^{a}	2.00^{b}	0.87^{b}	1.62^{b}	1.50^{b}	1.75^{b}	2.12^{b}	4.00^{b}	2.87^{b}	2.00^{b}
OIPCD	90.83^{a}	36.48^{b}	30.71^{bc}	16.71^{bc}	13.57^{bc}	16.19^{bc}	19.50^{bc}	24.02^{bc}	19.41^{bc}	10.86^{c}
OVCI	5.5^{a}	0.5^{b}	0.87^{b}	0.37^{b}	0.87^{b}	1.25^{b}	0.5^{b}	1.37^{b}	0.75^{b}	0.62^{b}
Paratyphoid	0.62^{a}	0.25^{a}	0.00^{a}	0.00^{a}	0.00^{a}	0.12^{a}	0.37^{a}	0.37^{a}	0.25^{a}	0.25^{a}
Typhoid	1.39^{ac}	2.07^{a}	6.61^{b}	8.26^{b}	6.00^{b}	3.14^{c}	1.46^{a}	1.34^{a}	0.75^{a}	0.87^{a}

There was a significant difference in female subjects among all the age groups for typhoid, BD, OBI, and OVCI, while no significant difference was detected for the other FRD (Tab. 3). Similar to male subjects, most FRD diseases except for typhoid were reported mostly for newborns. The most frequent occurrence rate of typhoid was reported for the 15–24 age groups ($P \leq 0.05$) of women followed by the 5–14 and 25–34 age groups, with the lowest occurrence rate for the age group >75. The occurrence rates based on the records of BD for female subjects in decreasing order of age groups were as follows: 0 > 1-4 > 25-34 > 35-44 > 15-24 > 45-54 > 5-14 (Tab. 3).

Table 3. Female age distribution of foodborne diseases reported in Turkey between 1960 and 2010

Disease	Age group									
	<1	**1–4**	**5–14**	**15–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65–74**	**>75**
BD	3.81^{a}	2.11^{b}	0.64^{c}	0.5^{c}	0.19^{c}	0.47^{c}	0.52^{c}	1.02^{bc}	1.23^{bc}	1.76^{bc}
Brucellosis	0.62^{a}	0.37^{a}	0.12^{a}	0.00^{a}	0.25^{a}	1.00^{a}	1.37^{a}	3.12^{a}	1.75^{a}	4.25^{a}
GD	936.1^{a}	218.7^{b}	35.3^{c}	11.8^{c}	8.7^{c}	10.9^{c}	19.4^{c}	25.9^{c}	31.7^{c}	29.3^{c}
MI	390.2^{a}	83.5^{b}	25.7^{b}	16.1^{b}	16.8^{b}	14.9^{b}	18.0^{b}	22.6^{b}	26.0^{b}	21.1^{b}
MCNSI	2.62^{a}	3.62^{a}	2.5^{a}	1.5^{a}	0.62^{a}	0.75^{a}	1.5^{a}	1.25^{a}	1.00^{a}	0.62^{a}
OBI	8.25^{a}	2.75^{b}	2.12^{b}	1.62^{b}	2.75^{b}	1.12^{b}	0.75^{b}	2.00^{b}	3.37^{b}	2.37^{b}
OIPCD	64.86^{a}	29.17^{b}	19.50^{b}	16.76^{b}	24.40^{b}	18.86^{b}	13.76^{b}	16.23^{b}	14.46^{b}	13.79^{b}
OVCI	3.62^{a}	1.0^{b}	0.12^{b}	1.00^{b}	0.37^{b}	0.50^{b}	0.37^{b}	0.87^{b}	0.87^{b}	0.37^{b}
Paratyphoid	0.00^{a}	0.25^{a}	0.25^{a}	0.00^{a}	0.00^{a}	0.12^{a}	0.25^{a}	0.5^{a}	0.12^{a}	0.12^{a}
Typhoid	1.54^{a}	2.35^{b}	4.66^{c}	7.23^{d}	4.33^{e}	3.47^{b}	2.59^{b}	1.59^{a}	1.35^{a}	0.64^{c}

In order to evaluate long-term behavior of each FRD best-fit least-square regression analyses were performed. Due to the fluctuations in the occurrence rate of each FRD, no distinctive conclusions can be made regarding the future trends of each disease. However, typhoid, GD, MI and OIPCD diseases led to R^2 values of 0.87, 0.89, 0.81, 0.84, and 0.83, respectively. The other reported diseases resulted in lower R^2 values than 0.60 (Tab. 4).

Occurrence rates and prevalence of foodborne diseases have been reported mostly by developed countries including USA, Canada, and Europe [6, 9-11, 16-18] along with mortality and morbidity rates, magnitude, direction, and future trends [6, 9, 16, 17, 19, 20]. Unfortunately, no reported data and long-term evaluations of foodborne diseases are available from developing countries (including Turkey) although these countries experience a rapid rate of population growth.

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Table 4. Best-fit least-square regression analyses of time series data for foodborne diseases that occurred in Turkey between 1960 and 2010

Disease	Regression equation	$R^2_{(adj)}$
BD	$y = -5.761\text{Ln}(x)+22.937$	0.78
Brucellosis	$y = 0.0575x^2-4.002x+72.918$	0.18
GD	$y = -0.4722x+19.464$	0.89
MI	$y = -0.0113x^2+1.9417x-11.42$	0.84
MCNSI	$y = -0.0116x^2+0.8055x-12.831$	0.03
OBI	$y = -0.1109x^2+7.735x-126.08$	0.20
OIPCD	$y = -0.7377x+27.458$	0.83
OVCI	$y = -0.0897x^2+6.6032x-116.91$	0.32
Paratyphoid	$y = 0.0039x^2+0.004x-0.5468$	0.45
Typhoid	$y = -2.8908\text{Ln}(x)+9.9688$	0.87

Another important issue with the data is that they do not have enough information such as detection of pathogenic causes, actions taken to cure the diseases, steps taken for legal procedures, and consequences of the diseases. For example, the occurrence rates of some diseases such as bacillary dysentery, typhoid, gastrointestinal diarrhea, diphtheria and OIPCD were diminished from 1960 to 2002; however, causes for these fluctuations were not correlated with social and economical facts. The reasons for this reduction in can be owing to improvements of hygiene and sanitary conditions in food production and processing plants, implementation of HACCP, GMP and ISO standards by food processing plants, their enforcement by government and local authorities, and/or increased quality of processing water. As opposed to the above mentioned diseases, the number of the reported cases increased for brucellosis and MI. One of the major pitfalls of the data records in Turkey was that the links of foods vehicle and disease agent to the reported disease were not explored. Although foods involved in these cases were not reported, there is a possibility that the increases in consumer demands for local and traditional cheeses produced from raw milk and the numbers of small cheese production plants grew the number of reports for brucellosis cases in the recent years. In their current state, these records do not suffice to understand disease agents, vehicles and contributing factors behind the diseases unless multiple correlations among them are explored. Previous studies about the incidents of foodborne diseases generally indicated most likely relationships between food vehicle and disease agent which in turn makes the reported incidents more useful [19-22].

It is well known fact that foodborne diseases are underreported, and these numbers represent only a fraction, maybe less than 1% of those who are actually exposed [23]. Hence, it is safe to assume that more than 99% of the cases in Turkey were not reported. It appears to be the reason why foodborne disease incidents reported were significantly less in this study than in Europe, United States, and Canada [6, 9-11, 16, 17]. As was also emphasized that legal authorities in Turkey should also strive to detect relationships among food vehicle, disease agent, history of food vehicle, and subsequent growth of pathogens in order to have a better understanding of foodborne diseases and outbreaks in the future [24].

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CANTEEN REFORM FROM THE PERSPECTIVE OF THE PARENTS OF NURSERY CHILDREN IN BÉKÉSCSABA

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ABSTRACT

It is important to provide sufficient quantity of good quality food for young children. The bases of healthy diet should be learned as a child and nurseries have an important role in shaping the children's eating habits and forming their taste. This paper summarizes research results about the canteen reform introduced in nurseries on 1st January, 2015. A total of 140 questionnaires were collected from parents or grandparents of the young children attending nurseries in Békéscsaba. We asked them about their pre-reform and post-reform opinions on the children's food and what they think of the implemented reform. The answers indicated that the parents were satisfied with the nursery caretakers who always gave detailed information about the child's meal and provided the possibility to discuss problems, most of the parents were well informed about the the nursery canteen reform and the majority agreed with it. Our proposals based on the research are: The parents should have more influence and their opinion should be asked about the catering of their children. Opinions of the nursery caretakers and the catering managers should also be considered, since they spend a lot of time with the young children at the nursery. The changes in the nursery catering should have been implemented more gradually.

Keywords: nursery, canteen reform, questionnaire, Békéscsaba

1. INTRODUCTION

It is well known to everybody in Hungary that unhealthy nutrition, obesity and lack of active lifestyle is an increasing threat to a significant part of the population. Those who try to do something about it try to do sports and to try eat healthy. Some people believe that the bases of healthy diet should be learned as a child but since the child does not see this at home, this matter should be solved in public institutions. Based on this concept the so-called canteen reform was introduced and has come into force from 1st January, 2015.
Every parent knows that the development of good habits should start in infancy. The taste of the infant develops as the parents and the caretakers shape it. If the infant does not get used to sweet taste, he or she will not like it and will accept the natural taste of the food. If, instead of sugary soft drinks and syrup, we give hundred per cent freshly-squeezed juices and clean water to drink, we do a lot for the infant's health and ensure his or her balanced development [1].
Due to the above mentioned, our research was done in nurseries. We have examined the effects of the introduced reform on young children, their parents and their caretakers. For this purpose, we have chosen the preparation of structured interviews (with nursery caretakers and catering managers). This study presents the results of the qualitative methods.
The fact that the child eats enough can be judged by whether he or she is satisfied or not and his or her development seems continuous or not. A healthy infant and young child never loses appetite. The child who eats only a small amount of food, but eats heartily and with joy does not have a bad appetite. The psychological conditions have effect on tolerance, metabolism and the processing of nutrients too [2].
Therefore, the above mentioned mean a careful, deliberate and thoughtful task [3]:

- Planning a menu which is diverse, coordinated in taste and form, appropriate for age and season.
- The knowledge about the infant or toddler: their individual needs, level of development, eating frequency, the quantity and quality of food and their way of eating (on lap, by the table, with help or alone, drinks while eating or only after eating).

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- The impact of the environment (precise preparation, nicely set table, balanced and relaxed atmosphere).
- The behaviour of the people nurturing the young children.

It is especially important to provide sufficient quantity of food for the children with the qualitatively correct composition. Children get breakfast, snack, lunch and afternoon snack in the nurseries. Using the appropriate kitchen technology, the enjoyment value is also being taken care of. It is a requirement that the meals of the adults and the children are prepared based on a different menu and the same raw material is avoided in the kitchen. These rules must be observed in all circumstances [4]. In addition, there are numerous recommendations on what kind of and how much nutrients should be provided for the toddlers, for example: One of the small meals in the nurseries should also contain animal protein [5]. Excessive salt intake should be avoided and the usage of sugar should be as minimal as possible [6].

In the case of recommendations, we must mention the well-known nutrition experts, who highlight the following (table 1): The recommended daily calories for the 1-3-year-old group is 1,537 kcal. From the daily calories 800-950 kcal should be provided in the nursery with four meals (2 small and 2 main meals), where the percentages are: 54% carbohydrate, 32% fat and 14% protein. The daily recommended amount of the carbohydrate is 206 grams, of which the added sugar can be maximum 10%, and the smaller the amount, the healthier the menu. The amount of fat is 55 grams, of which the essential fatty acid must be 28 grams. The total amount of protein should also be 55 grams, including 33 grams of proteins of animal origin which is 60% of the total amount. Proteins of animal origin are indispensable for young children because these proteins are the building blocks of the body. That is why the vegetarian diet is strictly forbidden and unacceptable for the developing, young children.

Table 1. Table of food nutrients for nursery-age children (Source: [7])

Nutrients	**Age 1-3**
Energy	**1,537 kcal**
Total protein	**55g**
Protein energy	14%
Animal protein	33g
Proportion of animal protein	60%
Total fat	**55g**
Energy proportion of total fat	32%
Essential fatty acid	28g
Total carbohydrates	**206g**
Energy proportion of total carbohydrates	54%
Added sugar	10%

We have formulated three hypotheses prior to the commencement of our research:

1. At least 80 per cent of the parents are satisfied with the fact that nursery caretakers give detailed information about the toddler's meal and provide the possibility to discuss the occurring problems.
2. At most 50 per cent of the parents are well informed about the implementation of the nursery canteen reform.
3. At least 70 per cent of the parents disagree with the implementation of the reform.

2. MATERIALS AND METHODS

During the survey, fifty questionnaires were distributed in Békéscsaba in each nursery. A total of 150 questionnaires were given to the parents or grandparents of the young children attending nursery. The data collection was carried out from March till May, 2016. A total of 140 assessable questionnaires were collected.

The questionnaire was divided into two main parts based on the date when the child started to attend the nursery. Those, whose children or grandchildren attended the nursery before 1st January, 2015 (that is,

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before the introduction of the reform), had to fill in the first and the second part as well. In cases, when the child started to attend the nursery after implementing the reform, the parent or grandparent filled in only the second part of the questionnaire.
We have evaluated the completed forms with the help of Statistica 13.0 and Microsoft Excel 2010 software.
The three hypotheses mentioned in the introduction were also tested at 5% significance level with z-test. The empirical value of z can be calculated as in (1) by taking the portion of the sample meeting the criterion (k), the sample size (n) and the hypothetical value to compare with (P):

$$Z = \frac{k - nP}{\sqrt{nP(1-P)}} \quad (1)$$

The value of z -test then has to be compared to the critical value of z at 5% significance level to decide whether the hypothesis can be accepted or has to be rejected.

3. RESULTS AND EVALUATION

The respondents of our research had the following demographic characteristics: they were typically female (95.72%); their age was between 26 and 45 years (87.90%); most of them were living in Békéscsaba (95.00%); and almost fifty-fifty per cent graduated from high school or had an academic degree.
Seventy-five per cent of the interviewed (105 persons) had a child attending the nursery before 1st January, 2015 (i.e. before the introduction of the reform), while twenty-five per cent (35 persons) enrolled their child into nursery after 1st January, 2015.
The pre-reform opinions (the first part of the questionnaire) can be summarized as follows: the respondents of the survey were typically satisfied with the taste, the size and the appearance of the food. Parents had the opportunity to get to know the food on so-called "health days" and during the transition period. Fig. 1-3 shows their opinions which were measured on a scale of 1 to 5 (1: not at all suitable/not satisfied, 5: fully suitable/satisfied).

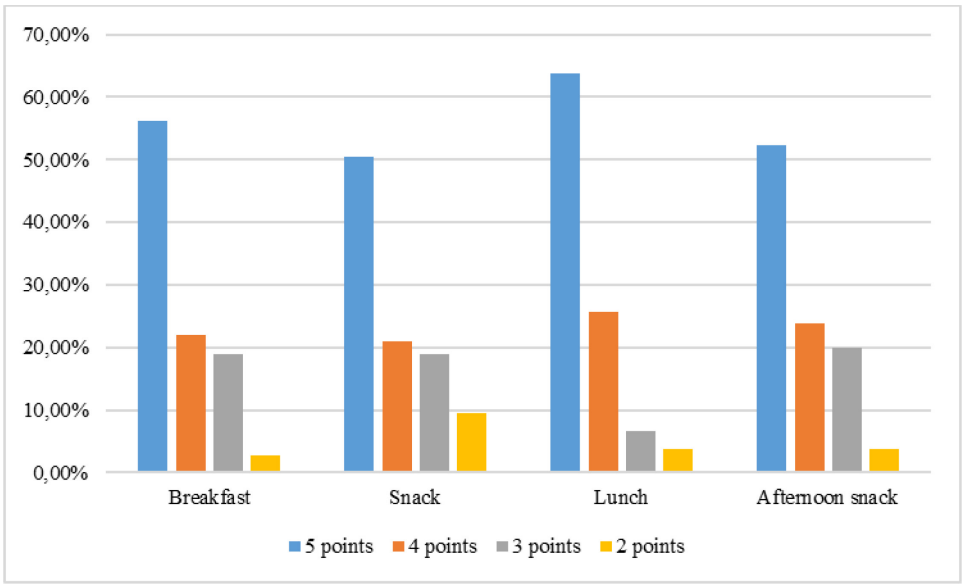

Figure 1. The evaluation of the size of portions in public catering before the reform (n=105) (Source: authors' edit)

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Hereinafter all parents responded to the questions, making the sample size 140. First, we asked about the knowledge related to the catering reform in the second part of the questionnaire. Based on the results we can say that approximately half of the parents tried to check on things, while the same percentage read about it one or two things. The percent of indifferent parents were insignificant. Then we tried to evaluate the opinions on the reform. From the eight possible answers, more than one could be marked by the participant (fig. 4). This time the results were not as unified as in the previous case.

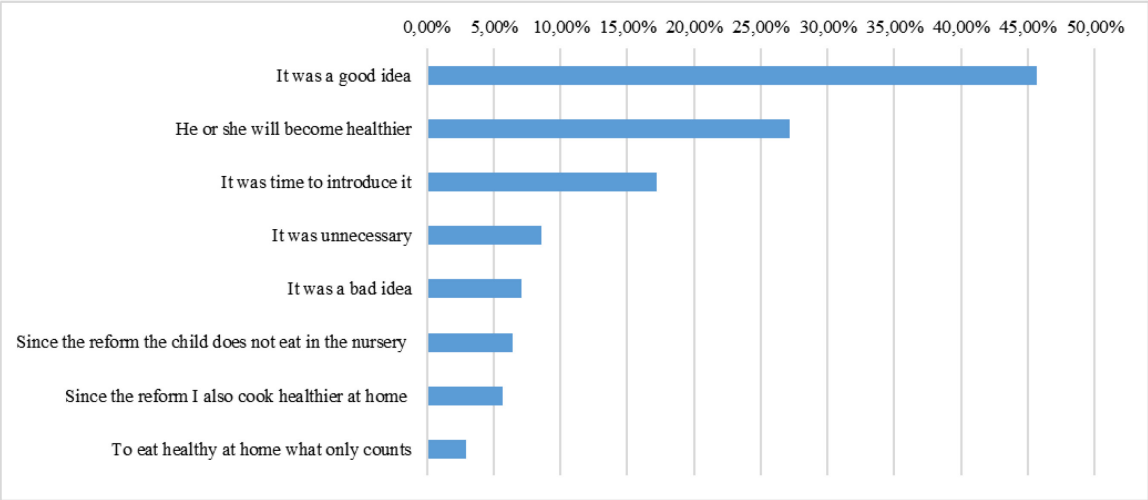

Figure 4. The distribution of the respondents based on their opinion on the reform (n=140) (Source: authors' edit)

The questions about the reform were followed by the same questions found in the first part of the questionnaire.

The taste, quantity and appearance of the food was evaluated on a scale of one to five, just as in the first part. We have found that the biggest difference was in the taste of the food. Parents gave five points to the taste of the food in far fewer cases than before the reform. The obtained results can be seen in table 2.

Table 2. Percentage of the fully satisfied respondents in the case of post-reform food evaluation (%, n=140) (Source: authors' edit)

Size of portions	
Breakfast:	48.6%
Snack:	45.7%
Lunch:	57.9%
Afternoon snack:	50.0%
Taste of food	
Breakfast:	43.6%
Snack:	37.1%
Lunch:	24.2%
Afternoon snack:	46.4%
Appearance of food	
Breakfast:	58.5%
Snack:	57.1%
Lunch:	45.7%
Afternoon snack:	57.1%

We have found significant difference considering the children's hunger. A higher percentage of the parents marked "always" (36.4%) or "usually" (30.0%) than before the reform, when this was only 17.2%. The

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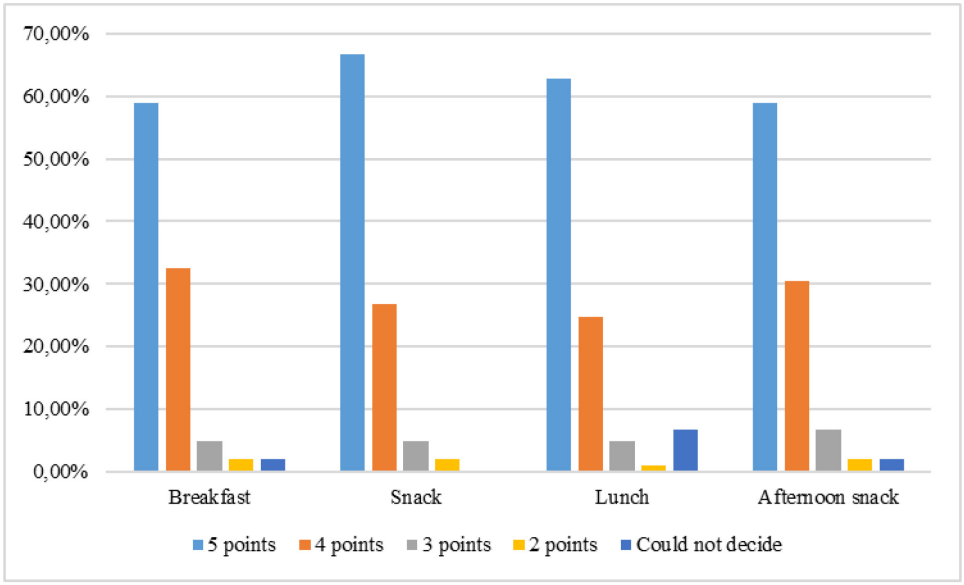

Figure 2. The evaluation of the taste in public catering before the reform (n=105) (Source: authors' edit)

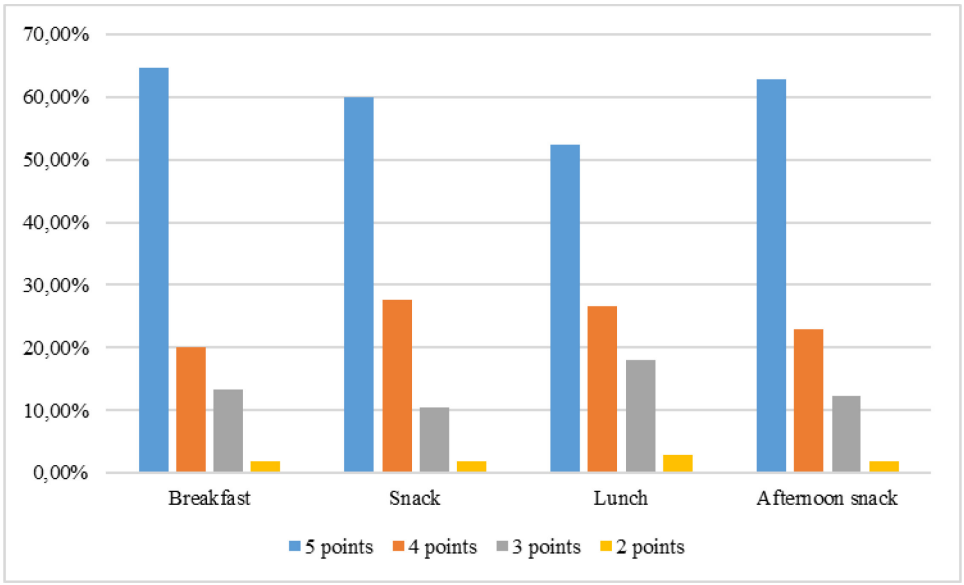

Figure 3. The evaluation of the appearance of the food in public catering before the reform (n=105) (Source: authors' edit)

Due to the child's age, the parent cannot expect a detailed report regarding the daily meal. Instead, he or she can decide if the toddler has eaten enough based on the child's hunger. The answers given to the question about this fact showed that 57.1% of the children never remained and 25.7% rarely remained hungry before the reform. Only 17.2% indicated that his or her child was always or almost always hungry when met at the end of the day. In addition, we also learned that most of the children willingly ate what he or she was given at the nursery (64.8%) and only 8.5% turned out to be picky. The parents could get this information from the nursery caretakers with whom they discussed the experiences in all details every day.

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feedback of the caretakers also support that the group of kids picky earlier, before the introduction of the reform, has grown from 8% to 20%.
In the last question of the survey, we asked the parents and grandparents on their views on the reforms. Here are a few opinions of which some support and some oppose the reform:

- "The taste of the previous foods was better; I would bring back those."
- "As long as the children heartily eat the offered food, there is no need for a reform."
- "Sometimes less healthy food may be allowed."
- "This is perfect as it is."

Many people had noted that the reform should have been introduced more gradually and several of them had mentioned that the dishes could have homelier taste instead. Some thought that the reform was completely unnecessary. According to them, the food was tastier in the past and the children's health does not depend on this.
In order to examine the three hypotheses, we have performed left and right tailed tests; table 3 contains the results.

Table 3. The results of the hypothesis tests (Source: authors' edit)

	1st hypothesis	2nd hypothesis	3rd hypothesis
H_0	$p \geq 0.8$	$p \leq 0.5$	$p \geq 0.7$
H_1	$p < 0.8$	$p > 0.5$	$p < 0.7$
k	136	67	73
n	140	140	140
P	0.8	0.5	0.7
Z_{crit}	-1.645	1.645	-1.645
Z_{emp}	5.071	-0.507	-4.611

4. DISCUSSION AND CONCLUSIONS

Our first hypothesis was that at least 80% of the parents are satisfied with the fact that nursery caretakers give detailed information about the toddler's meal and provide the possibility to discuss the occurring problems. It was clear from the parents' answers that it was always possible to discuss problems. The parents were always given information about their children's meal. Following the introduction of the reform 77.1% (108 persons) said that they had discussed everything in details with the nursery caretakers and another 20% (28 persons) did not find any problems to discuss. Nobody marked the answer that the caretakers refused the discussion or did not provide information. The interviews with the caretakers of the young children support this, since they all reported that they had given the parents information daily, but if there was a need for a longer conversation about an emerging problem, this could be arranged after making an appointment. The opinion of nutrition manager in the nursery was the same.
The calculated empirical value of the left tail z-test (z_{emp}) is higher than the critical value (z_{crit}), so we can accept the first hypothesis at 5% significance level.
Our second hypothesis was that at most 50% of the parents are well informed about the implementation of the nursery canteen reform. The questionnaires revealed that 47.9% of the parents were aware of the implementation of the reform and they had detailed information about it. Approximately the same percentage of the parents read about the reform but not in detail. Only a minor percentage (1.4%) did not hear about it and 2.8% replied that they were not interested in the topic.
The calculated empirical value of the right tail z-test (z_{emp}) is lower than the critical value (z_{crit}), so we can accept the second hypothesis at 5% significance level.
Finally, our third hypothesis was that at least 70 per cent of the parents disagree with the implementation of the reform. In the case of the relevant question, the respondents were allowed to mark more than one of the eight possible answers. The "I find it a good idea" answer was marked by 64 persons and 24 chose "It was timely". Eight respondents have been cooking healthier since the introduction of the reform. Altogether this is 96 people of the 140 (68.5%). The reform was a bad idea according to 10 individuals and 12 people

thought it was unnecessary. The child of 9 parents have not been eager to eat in the nursery since the implementation of reform and 4 parents thought that it was the home meal what only counts. These numbers add up to a total of 73 people (52.1%). The majority therefore agrees with the implementation of the canteen reform.

The calculated empirical value of the left tail z-test (z_{emp}) is lower than the critical value (z_{crit}), so we have to reject the third hypothesis at 5% significance level.

Our proposals are summarized as follows:

- Parents should have more room and more influence. Their opinion should also be asked about the catering of their children in the institution. For example, there could be an online forum for comments and opinions and these could be monitored and used by professionals to modify the reform.
- The realization of the reform should be the outcome of a multi-month, or even a one-year process. The consumption of sugar and salt should have been gradually reduced, and the introduction of new spices should have been carried out similarly to the introduction of new flavours recommended in infancy.
- In the case of the reform, the opinions of nursery caretakers and catering managers should also be considered, since they are the ones who spend the most time with the young children after the family.

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CONNECTION BETWEEN THE DEBRANNING TIME AND THE KERNEL HARDNESS OF WHEAT

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ABSTRACT

Surface cleaning has an important role in the technology of milling of wheat considering food security. Wheat hardness has an effect on the milling process, it determines the properties, qualities and end use of flours. In the last decade new debranning methods have appeared, which are able to better remove the shell of wheat grains applying rubbing surfaces. In my thesis I examined how different levels of debranning affect hardness and content of ash in wheat types with different grain structure. Conclusion is with approximately 4% of shell removed the hardness of grain. Further removing of shell does not result in further changes though. Reduction of hard wheat's general grain size with longer debranning process is larger compared to soft wheat's.

Keywords: PeriTec technology, SATAKE, debranning, wheat kernel hardness

1. INTRODUCTION

In the last 25 years, the importance of endosperm classification (soft and hard wheat kernel) has grown bigger. Wheat-hardness is an important parameter of wheat quality, the wheat hardness has an effect on the milling process, it determines the properties, qualities and end use of flours. In recent years the debranning of kernels before milling has moved to the forefront. The kernel hardness has great effect on the baking properties (water absorbent capacity, mixing time, kneading time) of the resulting flour. Flour, which is made from hard wheat generally have a medium to high protein content and stronger gluten than flour, which is made from soft wheat [4]. The friabilin protein complex determines the kernel hardness. Generally, when the amount of the friabilin is high, the kernel hardness is soft and when the amount of the friabilin is low the kernel hardness is hard. Kernel hardness is an important measurable attribute of wheat that has been correlated to it's chemical and genetic make-up. The evaluation of wheat kernel hardness has been used in predictions of flour yield and gives early indication of baking performance [5]. Factors influencing kernel hardness include variety and environment, however the total variation in hardness has yet to be explained. Hardness is suggested to influence the adhesion forces between starch granules and protein matrix whereas vitreousness would rather be related to the endosperm microstructure [2].
Ref. [1] based on a process of peeling, which is traditionally milled grain products (rice, barley, oats) are used during production. Funds that intense influences (peeling, grinding) on the grain surface of the shell is detachable parts, the outer layers of the kernel can be removed.
The bran of wheat kernel branch makes up 14-16%, which is the outer skin layers, including the aleurone layer. The latter is usually removed together with the other layers during milling technology, although botanically the aleurone layer is the outer layer of the endosperm [6]. Bottega et al [1] highlight the fact that the wheat peeling allows the removal of the outer skin layers and keeping the aleurone layer in a controlled manner.

1.1. PeriTec technology

The essence of the PeriTec technology - originally developed by SATAKE, a Japanese company, to clean rice - is that it gradually removes the bran layers of the grain by mechanical means before further processing. During our experiments we dealt with the laboratory modelling of a new milling surface treatment called PeriTec technology to find out to what extent this method can use to debranning wheat.

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The aim of our work was to demonstrate and compare the changes in different parameters of wheat kernels, ash content, percentage of broken kernels, peeled bran content, Hardness Index as the function of debranning times.

2. MATERIALS AND METHODS

We have two different kernel hardness Hungarian wheat varieties: sample 'A' was the soft kernel hardness, and sample 'B' was the hard kernel hardness. Sample 'A' and 'B' were air-dried (at 10-11% humidity) and 15% moisture content, they were carried out in the conditioned state experiments. The conditioning was calculated based on the initial moisture content and weight of the amount of wheat, with tap water at 20 °C. After conditioning the samples to a moisture content of 15%, they were subjected to different levels of rubbing applying 0, 10, 20, 30, 40 and 50 s operation times.
To the debranning we used PeriTec technology. The essence of the PeriTec technology - originally developed by SATAKE, a Japanese company, to clean rice - is that it gradually removes the bran layers of the grain by mechanical means before further processing. We modelled the PeriTec technology with a laboratory size, batch-operating, horizontal debranning machine by SATAKE (Figure 1.).

Figure 1. SATAKE machines

We studied the development of the physical parameters of the wheat grains, as well as the rate of grain breakage. We determined the ash content of the samples according based on MSZ 6367/15-84. We used a Perten SKCS 4100-type instrument to measure kernel hardness (Hardness Index).
The Perten SKCS 4100 instrument is one of the well know machines, which examine the kernel hardness. This device measures kernel texture by crushing the kernels one at a time, recording the force required to crush the kernel, and reporting the average force for crushing 300 kernels, in terms of a hardness index (HI) [3].

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Figure 2. Perten SKCS 4100 machine (Perten Inc)

3. RESULTS AND DISCUSSION

Examine the function of the various grinding times (0, 10, 20, 30, 40, 50 seconds), the detached shell, the broken grains rate and ash content, we can be a following conclusion: more grinding time with the SATAKE laboratory peeling equipment, more hulls have been removed.
As the mass ratio and the detached shell material grew, it reduced the ash content of wheat. The grinding time is increased by the shell content of endosperm has also been discarded parts. The increasing grinding time, the sample had a greater amount of mechanical stress, which resulted in a growing proportion of broken grains.

Table 1. The results of removed parts and ash content

Wheat sample	Debranning time (s)	Removed parts (%)	Ash content(%)
'A' sample	0	0.00	1.69
'A' sample	10	4.30	1.62
'A' sample	20	10.05	1.47
'A' sample	30	18.75	1.32
'A' sample	40	27.78	1.26
'A' sample	50	34.33	1.20
'B' sample	0	0.00	1.78
'B' sample	10	3.90	1.76
'B' sample	20	8.85	1.62
'B' sample	30	13.88	1.42
'B' sample	40	18.53	1.32
'B' sample	50	22.00	1.26

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The removed part of the soft wheat sample (’A’ sample) was higher than the hard wheat sample (’B’ sample), because more endosperm part of the wheat was removed (it is go away with coat of the kernel). When the debranning time is more the removed parts will be more. The polishing time is increased by the shell content of endosperm has also been discarded parts. As the mass ratio and the detached shell material grew, it reduced the ash content of wheat.

3.1. Result of SKCS

Kernel weight of the samples measured by SKCS

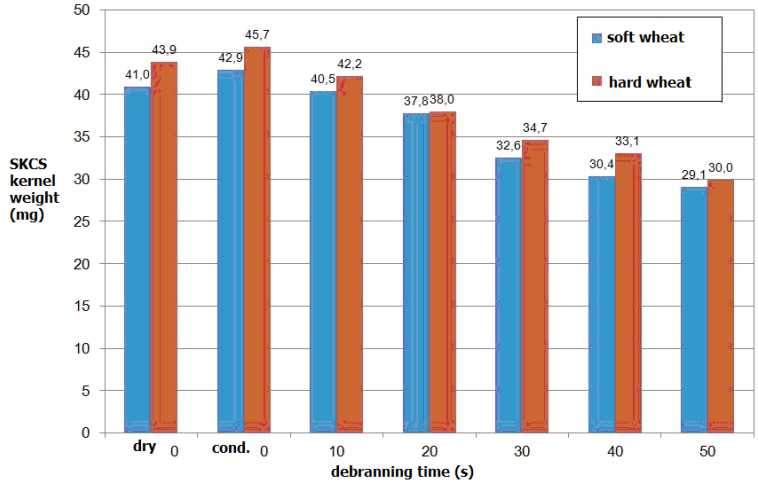

Figure 3. Results of Perten SKCS kernel weight of wheat samples

The graph clearly reveals that a weight of the wheat in the air-dry condition is slightly lower than the conditioned wheat samples. During the debranning of wheat to lose weight, it is mean the outer coat losing. At the beginning the weight of hard wheat (’B’ sample) is greater than the weight of the soft wheat (’A’ sample). The debranning degree is increase and it is reduce the mass proportion of the kernel, the reduction can be made between 3-15 mg.

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Kernel size of the samples measured by SKCS

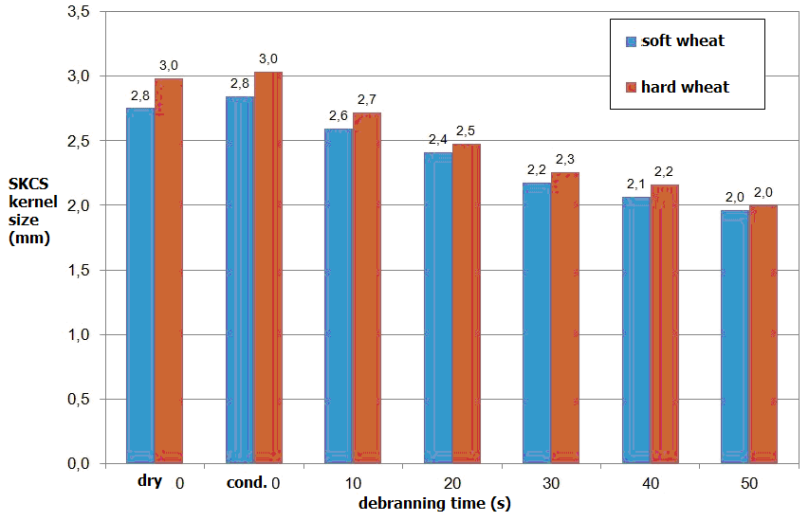

Figure 4. Results of Perten SKCS kernel size of wheat samples

There is no difference between the air-dry wheat size and the conditioned wheat size. After the debranning the size of kernel decreased steadily, the longer debranning of a sample, the reduction of the kernel size was greater.

Kernel moisture content of the samples measured by SKCS

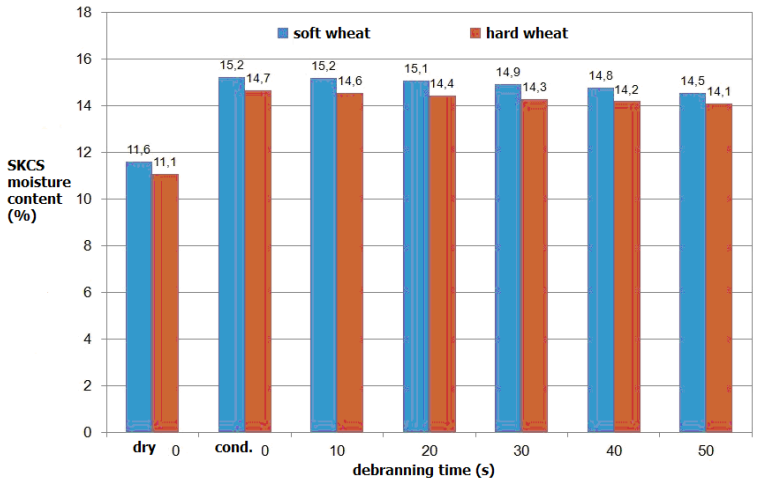

Figure 5. Results of Perten SKCS moisture content of wheat samples

The moisture content of the air-dry wheat is 11-12%, the conditioned wheat moisture content is between 14-15%. After the different debranning time the moisture content is reduced somewhat, which could happen due to the material dries.

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Kernel hardness of the samples measured by SKCS

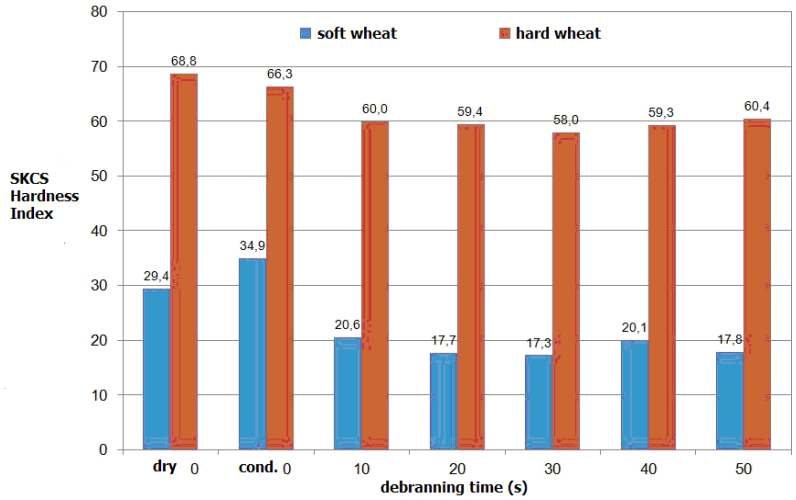

Figure 6. Results of Perten SKCS Hardness Index of wheat samples

The Hardness Index of the hard wheat (’B’ sample) was between 60-70, and the soft wheat (’A’ sample) is between 17-35. After 10 s debranning time the Hardness Index decreased both samples. There was no significant difference between the 10-second and 50-second debranning time.

4. CONCLUSION

Same debranning time causes higher debranning losses in the soft wheat (’A’ sample), than the hard wheat (’B’ samples). The reason is the soft wheat kernel was broken easily and more removed parts were generated. As a result of debranning, the 40 s treatment reduced ash content of wheat, over this, it has not changed significantly. The 10 s debranning effect is approx. 4 % decrease of the wheat part, the hardness index decreased in both samples.
The associations found in this study will help to better understanding the wheat kernel hardness and wheat debranning technological aspects as well as provide useful information to breeders to develop new, high quality hard a soft wheat varieties.

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ECONOMIC CALCULATIONS OF AN INVESTMENT OF A SLICING AND PACKAGING PRODUCTION LINE OF A MEAT PROCESSING FACTORY IN CSONGRÁD COUNTY

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ABSTRACT

We test a Csongrád county meat-packing factory's new slicing-packing production line's investment. We value the different tenders from five main viewpoints, these are the following: the NPV (Net Present Value), IRR (Internal Rate of Return), DPB (Dynamic Payback), PI (Profitability Index), PB (Payback Time). During the calculation, we have experienced that both tenders would be viable financially. We recommended the offer of the GEA Group AG.

Keywords: investment, Net Present Value, Internal Rate of Return, Profitability Index, Dynamic Payback Period, Payback Period

1. INTRODUCTION

Investment refers to those complex material and technological steps which aim is to procure, set up new tangible assets, to replace, substitute overused tangible assets or to modernise, extend the capacity of already existing assets [1].
In accordance with Act C of 2000 Law on Accounting [2] the category of investment includes procution and setting up of tangible assets as well as their production by enterprises owned by the company; the commission of the procuted tangible assets, and operation carried out for the sake of intended operation before the commission as well as operation carried out before the intended operation. The extension of an already existing tangible asset, operation carried out with the aim of changing, transforming its intentional usage, increasing its lifetime and capacity also counts as investment. Furthermore, every operation in connection with the investment of a tangible asset, including planning, preparing, carrying out, loan application and insurance also counts as investment [1]. The aim of the economic calculation of an investment is to be able to compare investment companies in the phrase of decision foundation and be able to choose the one which is the most suitable for our purposes.
The aim of our research was to carry out the investment-economic calculations based on the two tenders previously requested by the client company. It involves the calculation of net present value, internal rate of return, profitability index, payback time and discounted payback time, on the basis of which we were able to find the most economic choice for the company from financial point of view and we suggested the management to carry out the investment in accordance with this. The aim of the investment was the slicing-packaging process line.

2. THE MOST IMPORTANT INFORMTION REGARDING THE INVESTMENT

In order to realise our aim four dynamic as well as a static investment-economic calculation were carried out. Before introducing the formulas in connection with them a few basic terms is described in connection with the topic.
In case of most companies the most important decisions within the scope of long-term investments are in connection with decisions about investments. Creation investment decisions is regarded the most important field of corporate finances. Since the majority of investments means a one-time expense, their realisation takes a long time and the income generated by the investments appears later and their appearance is

uncertain investments influence the technical and technological features and economical- financial situation of the company on the long run [3].
The investments were realised in several different tangible assets; with the procurement and setting up of those the company aims to realise a previously concretized goal. These goals among others can be the increase of the profit and market share of the company, the reduction of the costs of the company, replacement of the old and worn out assets as well as meeting the regulatory requirements and laws [3].
When assessing the investment proposals the analysts have made a decision about that in case of the realisation of the investment it will increase the market value and the owner's assets or not. Naturally, only those assets increase the asset of the company which worth more than their cost thus their operation will result in more income than its investment cost [4].
The financial assessment of the proposals is a special field of business analysis since it is not the subsequent examination of revenues, costs and incomens that is being carried out, but it is executed regarding the future [3].
For the assessment of the projects it is advasible to estimate factors such as the usable life-expectancy of the investment, money-flow in connection with the investment and intest rate necessary for the discounting of the cash flow [3].
The useful life of the investment lasts from the date of the installation to the decommissioning due to legal, technical or economical reasons. Since income generated via the project is greatly influenced by the useful life, the analyst has to focus on finding out what is the optimal usage time of the equipment [3].
The evaluation of investments is a much more complicated task than the evaluation of the financial assets. Estimating cash flow is only a part of the tasks of the analyst. Information is required for the estimation. The company can acquire these pieces of information from different professionals who are quite familiar with the technical features of the project. After this the decisionmakers decide if the project is worth implementing. [3].
Another reason why estimating the cash flow of investments is a complicated task is because of the fact that there are only a few so-called greenfield investments- in case of which it is the easiest to assign cash flow. Most of the cases investments are realised by companies which are in operation for a long time, where the equipments produce the income together. In this case it is impossible to calculate the contribution of an asset to the future income [3].
When an investment proposal is examined from a financaial point of view what is being considered is whether during the operation there will be enough income generated during the useful life to result in the expansion of the company. Thus the relevant cash flow in connection with the investment will be the operational cash flow [3].
For the real value of the projects it is necessary to know which incomes and costs can be considered for calculations when estimating cash flow [3].
The following rules should be considered when estimation cash flow.
First, cash flow should be estimated on growth-basis. In other words, every cash flow which in case of approval of the project could result in change in the revenue, costs or in the taxes payable, should be inserted into the analysis. This is the only regulation which guarantees that each and every investment is judged by its own values [5].
The cash flow should be measured on the after tax base. For taxes actual pay out is carred out thus, if a decision-maker maximises the value, he calculates with the after tax profit. On the other hand, it realisation of the investment itself is carred out from the after tax money. Bearing all this in mind, it becomes clear that it is possible to remain consequent only if cash flow is calculated with the net value [5].
The indirect effects of the project should also be taken into consideration. It is in connection with the estimation of the cash flow on a growth basis. Projects could have favourable and unfavourable effects. Most of the cases it is possible in case of a new product because it is possible that because of the new product the volume of the old one decreases. The above mentioned effect is called erosion. In this case the estimated revenue of the new product has to be modified to compensate for the loss generated by the devaluation of the old product [1].

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The sunk costs should not be taken into consideration. These costs are generated previously or expenses which are in connection with the project however their return does not depend on the realisation of the project. Only those basic costs should be taken into considerton which were paid after the realisation of the investment [1].
The alternative costs of the already existing resources used for the investments should also be taken into consideration. The alternative cost of the capital is not in connection with the acquisition of an equipment but it is waiving of a benefit. The alternative cost of an already existing asset is a cash flow which is generated by the asset in case of an unplanned investment [3].
The net working capital (working capital need) should also be taken into consideration. The difference between the current assets (inventory and receivables) and the short term liabilities (vendors) gives net working capital need. The nature of the net working capital it that by the end of the investment the the working capital releases and it can be utilised in other areas [1].
When estimating the cash flows cash flows in connection with financing should not be taken into consideration. This is due to the fact that it is the money income generated by the new equipment. In order to do so cash flow deriving from the operation of the equipment should be compared to the cash flow utilized for its acquisition [1].
The final part is the the consistent treatment of inflation. Distinction should be made between nominal and real interest rate. If nominal interest rate used as a discount rate than cash flow should also be estimated nominally, however, in case of using real interest rate, prices should not be changed. Using nominal interest rate is typical, what makes it difficult is that it is not necessary adavisble to use the same rate for all the cash flow since in this case cash flows changes in the same way [5].
There are three types of cash flow: initial, operational and final cash flow [3].
Intial cash flow means the total expenses during the investments. From the beginning of the invesvestment (the decision) to the commissioning. In order to calculate the initial cash flow it is adavasible to rely on the financial regulation on cost of the assets which gives the book value of the assets [3].
The initial cash flow consists of the following:

+ The purchase value of the asset/assets
+ Net working capital need
+ Capitalisable costs
+ Alternative cost of already existing resources
- Incomes deriving from the sales of old asset/assets [6].

When estimating the operational cash flow the changes in the income and costs of the company caused by the investment during the useful life is calculated [3].
The operationa cash flow of any period can be calculated in the following way:

+Revenue
- Current operating expenses
- Depriciation
Earning before interest and taxes (EBIT)
- Corporate tax
After tax revenue
+ Depreiciation
± Changes in net working capital
Net operational cash flow of the period [6].

The estimation of the final cash flow gives the amount which could be gained back after the operation of the investment from the originally invested amount. It has two main parts: the actual income from the sales of tangible assets and the released working capital [3].
Grouping project based on which life stage of the asset do they belong to is only one possibility. The other way is to group them according to how much change is possible in the sign of the cash flow during the useful life. Thus we can differentiate conventional and unconventional cash flows [3].

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It is typical for the conventional cash flow to have only one negative sign cash flow during the useful life of the investment. This is the initial capital cost in connection with the instalment. The operational cash flow is expected to have positive sign [6].
It is typical of the unnconventional cash flow to have a negative sign besides this, among the operational cash flow on can find negative and positive signs as well [3].
When evaluating investments there are two types of problems that financial anaysts have to face. One of them is whether it is worth implementing the investment or not. The other one is that from the two mutually exclusive projects which is the most suitable for the company [3].
Most of the companies have to face the first problem thus each and every offer should be analysed in connection with its financial viability [3].
The second problem arises when the company realises its goals vie two totally different projects. In this case financial viability of the investment should also be analysed and the most suitable should be chosen. There are several simple and more complicated calculations to help solve problems in connection with investments. Whichever method is chosen the following assumptions should be regarded as valid. Money in and outflow typically occurs towards the end of the year. Commissioning happens after the acquisition. Finally, the risk of future cash flow is equal [3].
Among the different calculations return time, discounted return time, net present value, internal rate of return and profitability index bear special importance.

2.1. Material and method

The two groups of calculations preceeding investments are called static and dynamic calculations [7].
In case of static calculations the capital value of money is not taken into account. Thus from the point of view of the decision makers the amount of cash flow generated during the useful life and their time of generation is not important. That is why nowadays these methods are not used any more. They are only concerned to be supplementary methods form dynamic calculations. The most well know statical index is the return time [7].
In case of dynamic method the time value of money is taken into consideration. Dynamic calculations are called calculations based on present value or techniques based on discounted cash flow. Calculating net present value (NPV), internal rate of return (IIR), profitability index (PI) and discounted payback belongs here [7].
Net present value is the most useful indicator when evaluationg investments [3].
It is calculated in the following way:

$$\mathrm{NPV} = -\mathrm{C}_0 + \sum_{\mathrm{t}=1}^{\mathrm{n}} \frac{\mathrm{C}_\mathrm{t}}{(1+\mathrm{r})^\mathrm{t}} = -\mathrm{C}_0 + \mathrm{PV} \tag{1}$$

Net present value (1) is a difference-type indicator which indicates the amount of net income growth by extracting initial capital investment from the discounted cash flow generated during the lifespan of the investment. C_0 in the formula indicates initial cash flow, C_t operational cash flow in every year, r indicates interest rate, t refers to useful life. PV is the total present value of operational cash flows, in other words net income, which means the income generating potential of the investment [3].

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Table 1. Decision criteria of net present value(Source: [8])

If	Meaning	Decision
NPV>0	The investmentis expected to increase the value of the company	Project should be accepted
NPV<0	The investment is expected to decrease the value of the company	Project should be declined
NPV=0	The value of the company is not expected to change because of the investment	Accepting or declining the project is neutral

Table 1 shows that project should be accepted in the case when net present value is bigger rhan or equal to zero because the value of the company will increase due to the investment or it will not change.
Net resent value has several strong and weak points as well. Among its strong points are that it takes into consideration the canges in the amount of cash flow during the time of investment. It only depends on the cash flow resulting from the projects and income level generated by the investments [2].
Its weak point is that it gives the income in absolute amount. Thus hiding the time in which the invested capital resulted in the income growth. Another fault is that instors calculate with percentages thus net present value in absolute amount is not the best way of inllustration [2].
Internal return rate shows the general return rate during the useful life [9].

$$-C_0 + \sum_{t=1}^{n} \frac{C_t}{(1+\mathrm{IRR})^t} = 0 \qquad (2)$$

In the formula (2) r indicates the expected yield t the useful life. C_0 indicates the initial cash flow, C_t the operational cash flow in every year [7].
IRR is a unique profitability indicator. In case of using this indicatior for evaluating investments, the rule is that internal return rate should be compared to expected yield [9].

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Table 2. Decisional criteria of internal rate of return (Source: [8])

If	Meaning	Decision
IRR>r	The expected yield of the investment is bigger than the expected yield	The investment is acceptable +NPV
IRR<r	The expectd yield of the investment is smaller than the expected yield	The investment should be declined - NPV
IRR=r	The expected yield of the investment equals the expected yield	It is neutral to accept or decline the project NPV=0

Table 2 indicates that the investment is acceptable if the internal rate of return is bigger or equals the expected yield.
Its adavantages are that it takes into account the total cash flow and their changes in time during the whole lifespan of the investment. In normal decision making it is easy to interpret because it equals the net present value [7].
Profitability index is a simplified version of net present value. The difference between the two calculations is that profvaitability index takes the proportion of cash flow instead of difference between the present value of cash flows generated during the time of the investment and the initial capital investment [9].

$$PI = \frac{\sum_{t=1}^{n} \frac{C_t}{(1+r)^t}}{C_0} \tag{3}$$

The other name of profitability index is yield-cost ratio because yield from the investment is compared to the costs of the project (3).

Table 3. Decision criteria of profitability index(Source: [8])

If	Meaning	Decision
PI>1	Every invested HUF1 is expected to result in more than HUF1 return in present value	The project should be accepted
PI<1	Every invested HUF1 is expected to result in less than HUF1 return in present value	The project should not be accepted
PI=1	Every invested HUF1 is expected to result in exactly HUF1 return in present value	It is neutral to accept or decline the project

It is clear from Table 1 that profitability index is ideal in case if its value is bigger than 1 or equals 1 because in these cases with every invested HUF 1 the return is expected to be exactly HUF 1 in present value or more than HUF 1.
The advantage of profitability index is that it is easy to calculate and in case of resurce limit in can result in better decision than net value [9].

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When ranking mutally exclusive projects and projects of different scale there is an opposite result to net present value thus it is difficult to interpret. It is considered its weakness [9].
Return time is the most well known static method which is not based on discounting. It indicates the number of years necessary for the operational cash flow to return the invested money [7].
The return time is the quotient of the initial capital investment and the expected yearly cash flow if we assume that cash flow generated during the operation of the asset is of the same in proportion in every year [7].

$$\text{Return time} = \frac{\text{Initial investment}}{\text{Expected net yearly cash flow}} \tag{4}$$

The return time (4) has several advantages and disadvantages as well. Among the advantages it can be mentioned that it is easy to calculate and interpret. Moreover, in case of especially risky future it provides information about the risk. It prefers viability since the shorter the return time the sooner the incoming cash flow can be utilized.
One of the biggest disadvantages is that it does not take into consideration the time value of money. Furthermore, during the average, the investment where profit is constantly rising is regarded as profitable as the one where profit occurs in the beginning of the period. It calculates by accounting profit, which can be manipulated to a certain level.
The last indicator is the discounted return time (5) which is a dynamic calculating method. It is developed version of return time. This decision making rule tries to merge the advantages of return time (indicating risk and liquidity) and dynamic methods. It expresses for how many years the investment should operate in order to be able to interpret it from the point of view of net present value. In other words, how many years of discounted profit is necessary for the return of the originally invested capital. It takes into account the time value of money but it does not calculate with the profits generated after the return time. Similarly to the simple return time, this method reflects the subjective criterias of the management [3].
It can be calculated in the following way

$$\text{PVIFA}_{(\text{r\%,n year})} = \frac{\text{Innitial investment}}{\text{Expected yearly cash flow}} \tag{5}$$

Here r is the expected yield by the owners. The useful life of the investment is indicated by n. The quotient of the initial investment and the expected net yearly cash flow can be find in the table showing the present value of annuity and that value gives the discounted return time. This value is supposed to be less in case of the useful life [3].

3. EVALUATION OF THE RESULTS

The client company asked our professional opinion about its lates planned investment. The company we examined planned to replace a slicing and packaging machine which had been in use for a long time. To replace the above mentioned production line several quotations were asked from different companies. Two quotations arrived, one from GEA Group AG and the other from Multivac Hungaria Kft. The company provided us with all the necessary information including the purchase price of each quotations (GEA Group AG: HUF 249 187 200, Multivac Hungária Kft.: HUF 255 875 600). The useful life of the production lines (5 years), the expected yield by the owners (10%), the corporate tax for 2016 (19%) and the expected costs and revenues necessary for the operational cash flow. With this information first the depreciation was calculated for both quotations. Then the operational cash flow of the two processing lines were calculated. Net present value, internal return rate, discounted return time and profitability index were calculate for both quotations as presented in the literature. A static calculation method was used, namely the return time.

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After the calculations the followind indicators were given.

Table 4. Comparison of quotations for the slicing and packaging production line (Source: own results)

Indicator	GEA Group AG	Multivac Hungária Kft.
Net present value (NPV)(HUF)	**33.979.255**	27.988.109
Internal return rage (IRR) (%)	**15,20**	14,20
Profitability index (PI)	**1,14**	1,11
Discounted return rate (year)	4,7	**4,6**
Return rate (year)	**3,34**	3,42

As it can been seen in Table 4 both quotations are favourable regarding every indicator for the company however, the offer of GEA Group AG is favourable. (With the exception of the discounted return rate in case of every indicators). The net present value is the highest in this case: HUF 33 979 255, which is bigger than 0, thus it meet this requirement. The internal interest rate is 15.20% which is bigger than the expected yield (10%). Profitability index is 1.14 which means that after every invested HUF 1 HUF1.14 is generated. Based the above mentioned we suggest the acception of the first offer. Thus we also suggest that the meat processing factory in Csongrád county should realise the project offered by GEA Group AG.

4. CONCLUSIONS

The meat processing factory in Csongrád county planned to replace a slicing and packaging production line which was in usage for a long time. Investment economy calculation were carried, based on which we made suggestion about that from the mutually exclusive offers which would be the most economical to realise. In order to do so we made four dynamic and a static investment economy calculations. The quotations proved to be viable for the meat processing factory of Csongrád county. Based on the indictors we suggest that the offer of GEA Group AG should be accepted since the return time of this is the shortest and the net present value is the highest, the internal interest rate and profitability index is the best.
The acquisition of the processing line was carried out in 2016 but the meat processing factory accepted the economically less favourable offer of Multivac Hungária Kft. The company admitted that based on the indicators the quoutation of GEA Group AG is favourable. The decision was explained by that the company has a long lasting business relationship with Multivac Hungária Kft which means security for them.

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PURIFICATION OF DAIRY WASTEWATERS BY ADVANCED OXIDATION PROCESSES AND MEMBRANE FILTRATION

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ABSTRACT

Membrane separation processes are space and cost-efficient, easy to scale-up operations, which have proved to treat food industrial wastewaters efficiently. Beside the advantages like high separation efficiency without any chemical changes and low energy-intensity, membrane filtration also has drawbacks, like decreased operational efficiency caused by flux decile resulting from fouling and concentration polarization. Combination of oxidation pre-treatment and membrane filtration is a promising method for decreasing fouling due to the physicochemical changes caused by pre-oxidation of the wastewater in structure of colloidal pollutants and in the interactions between the foulants and the membrane material. The aim of this work is to identify the parameters affecting the membrane fouling during treatment of dairy wastewaters, and present the current trends of research in this field.

Keywords: dairy wastewaters, membrane separation, advanced oxidation processes

1. INTRODUCTION

Water is used in most steps of food processing technologies, e.g. washing raw materials, cleaning, cooling and heating. Food industrial effluents typically contain high amounts of organic compounds e.g. proteins, carbohydrates, fats, and suspended solids. Among the food industries, dairy industry generates the largest volume of wastewater (from 0.2 to 10 L of effluent per litre of processed milk) due to large water consumption [1]. Other than organic and inorganic impurities dairy wastewaters contain detergents used for equipment cleaning [2] in varying quality and quantity throughout the day that changes with the seasons. These effluents have the following characteristics: biochemical oxygen demand (BOD), with an average ranging from 1,000 to 3,000 mg/L in the untreated effluent, chemical oxygen demand (COD) ranging from 2,000 to 5,000 mg/L, total suspended solids (TSS) at 400–1,000 (mg/L), total dissolved solids (TDS): phosphorus (10–30 mg/L), and nitrogen (about 6% of the BOD level). Levels of potential contaminants in dairy wastewaters typically exceed the levels considered hazardous for domestic wastewaters [3]. They may contain microorganisms including pathogens, from contaminated materials or production processes, and they often generate odours and, in some cases, dust, which also need to be controlled [4].
The conventional treatments of these effluents include the use of primary physical treatments to remove solids, oils and fats, secondary biological treatment to remove organic matter and nutrients, but several problems have been reported, such as high production of scum, low sludge settleability, low flexibility of the technology, difficulties in removal of nutrients (nitrogen and phosphorus) and problems in the oil and fat degradation [5]. Because of the reduction in water availability and the increase in water treatment costs, there are several researches for developing new technologies for wastewater treatment, not only aiming to meet the standards but also to obtain treated effluents feasible for reuse. Considering these, membrane separation techniques seem to be promising processes for the treatment of dairy industrial wastewaters. This work aims to collect results from recent studies of membrane filtration and advanced oxidation processes in relation to the applicability of these processes in purification of dairy wastewaters.

2. MEMBRANE SEPARATION OF DAIRY INDUSTRIAL WASTEWATERS

Several researches focused on membrane filtration treatment of dairy effluents concluded that microfiltration (6], ultrafiltration (UF) [4], nanofiltration (NF) [7], reverse osmosis (RO) [1] or two-stage operations such as UF+NF [8] may be appropriate methods to produce reusable water. Membrane

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treatment of dairy wastewaters with the aim of water reuse could simultaneously lower the total water consumption and the effluent production of the dairy plant, as the purified water produced by membrane treatment could be reused in the dairy factory as heating or cooling water, as boiler make-up water or for cleaning purposes.
Beside the advantages like high separation efficiency without any chemical changes and low energy-intensity, membrane filtration also has drawbacks [9]. The main disadvantage is the decreased operational efficiency caused by flux decile resulting from fouling and concentration polarization. Although the polymer-based membranes are cheap and available, their life time is limited and they require regular cleaning.
Eliminating contaminants from high turbidity wastewaters or removal of microorganisms can be realized by means of microfiltration and ultrafiltration due to their relatively low energy consumption and high initial flux. Microfiltration membranes possess significantly higher flux at a lower transmembrane pressure but lower retention compared to ultrafiltration membranes, and are also more prone to be fouled [10].

2.1. Membrane fouling components

Depending on the relative size of the particles and membrane pores, fouling can arise as complete or partial pore blockage or as formation of a deposited layer on the membrane surface. Beside these direct interactions between the colloidal particles and the membrane causing irreversible (non-washable) resistance during filtration, the particle-particle interactions result in washable cake/concentration polarization layer built up from retained colloidal particles at the membrane surface (Fig.1.). This causes a reversible resistance to fluid flow [11].

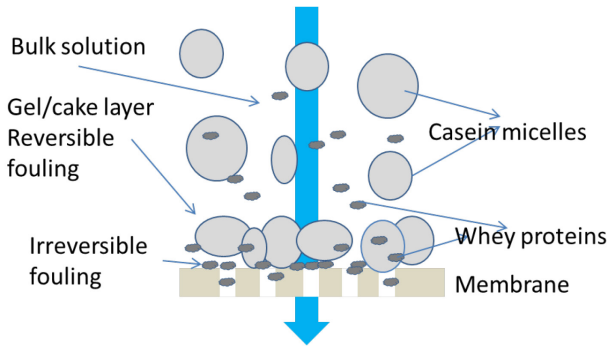

Figure 1. Fouling phenomena of milk proteins during UF [11]

Colloidal particles are clogging the membrane surface through physical and chemical interactions. Hydrodynamic driving forces applied during the filtration deliver the fouling particles to the surface, while binding to the surface is determined by colloidal interactions. Clogging of the membrane depends on the material, physical properties, and geometry of the membrane; pore size; roughness [12]; hydrodynamic conditions and the chemical nature of the foulants.
Various matters may cause fouling; in this work, the fouling propensity of typical dairy effluents are discussed. Dairy wastewaters contain the organic compounds of milk: proteins, fats, carbohydrates (lactose), minerals containing a high variety of salts e.g. sodium, potassium, calcium, magnesium, phosphate, chloride, sulphate, carbonate, and citrate [11,13] (Table 1).

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Table 1. Characteristics of the milk proteins related to membrane fouling propensities [13]

Proteins/Membrane material	Concentration in milk (g/L)	Size (kDa)	Size (nm)	IEP	Charge in neutral pH
Caseins					
α_{s1}-casein (α_{s1}-CN)	12–15	23.6	form casein micelles (50-300 nm)	4.96	negative
α_{s2}-casein (α_{s2}-CN)	3–4	25.2		5.27	negative
β-casein (β-CN)	9–11	24.0		5.2	negative
κ-casein (κ-CN)	2–4	19.0		5.54	negative
Whey proteins					
β-lactoglobulin (β-LG)	2–4	18.3	3-8 nm	4.6	negative
α-lactalbumin (α-LA)	0.6–1.7	14.2		5.35	negative
bovine serum albumine BSA	0.4	66.4		4.7	negative
Immunoglobulin G IgG	0.4	150–1000		6.1-8.5	negative/ positive
Membrane material					
Polysulfone (PS)				3.6	negative
Polyethersulfone (PES)				2.2–2.4	negative

Beside the natural components dairy wastewaters intermittently may contain detergents. Several studies have been performed to identify the components contributing to fouling in milk ultrafiltration. Caseins generally have an open structure, and most of them are present in milk as casein micelles (CMs); at native pH and room temperature, about 95% of caseins are associated as colloidal assemblies of micelles. The exact structure of the CM is not known, however it is generally accepted that κ-casein is located on the micelle exterior, its long hydrophilic sections extend into the serum, providing a ~7 nm thick layer that sterically stabilises casein micelles. [11]. Their size is ranging 50–300 nm in diameter [14]. Unlike caseins, whey proteins generally have tertiary and quaternary structures, which can influence concentration polarization and fouling behaviour of milk. Whey protein (β-lactoglobulin) exists as dimers held together by hydrophobic interactions (Lewis-acid-base interactions), but also exhibits different aggregation states depending on the pH. The most important mineral in milk is calcium phosphate, which is sparingly soluble, forms complex associations of calcium with other salts and milk components (like free caseins, citrates, and lactose) [15, 16], and stabilisation of calcium phosphate is provided by the presence of CMs.

2.2. Interactions between the membrane and pollutants

The membrane characteristics are changing by interactions between colloidal particles of the wastewater and the membrane, e.g. protein adsorption and mineral precipitation. The resultant fouled membrane has different physicochemical properties compared to the clean membrane, e.g. changed surface charge, [17] and reduced pore size.

Earlier studies [18, 19,20] have shown that in case of polymer membranes, irreversible fouling is caused mainly by proteins and not by minerals during the ultrafiltration of milk. Within the protein fraction whey proteins are the dominant foulants [21], due to their size (Fig.1.). The comparison of MF and UF studies on whey proteins indicated, that flux decline is greater during MF than UF [22, 23] due to the potentially pore-blocking particles for MF resulted in protein aggregation. Since both the original and the aggregated particles are retented by UF, ultrafiltration membranes cannot be fouled by them.

During filtration, proteins can adsorb directly onto the membrane surface. The phenomenon is determined by the (1) electrostatic interactions, as charge distribution on protein-surface contact, and (2) Van der Waals interactions, as hydrophobic interactions releases the water and ions from the protein and membrane

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[20, 24]. Proteins are amphoteric molecules, their surface charge (characterized by Zeta potential) strongly depends on pH of the solute (Table 1). In neutral solutions, major milk proteins and most of the polymeric membranes used in dairy industry are negatively charged. Since the interaction between proteins and membrane-proteins are repulsive; the presence of protein adsorption onto mainly hydrophobic surfaces indicates that the hydrophobic interactions are the dominant over the electrostatic interactions.

3. REDUCTION OF MEMBRANE FOULING

Membrane fouling can be reduced both by physical and chemical methods. Physical methods may be optimizing flow conditions at the surface of the membrane (e.g. stirring) or application of ultrasound or vibration [25]. Physicochemical or chemical methods aim to change the characteristics the membrane by modification of the surface [26] or modification of the colloidal-size particles (both hydrophilic and hydrophobic properties, the surface charge and the size), converting them to a form which cannot bind to the membrane surface, and/or can form associations of a size which are unable to penetrate the pores of the membrane [27].

3.1. Application of advanced oxidation processes

The combination of membrane separation and pre-treatment with advanced oxidation processes (like ozone, hydrogen peroxide, UV light and their combination) opens new opportunities, since the ozone and the resulting oxidizing (mainly hydroxyl-) radicals are efficiently changing the characteristics of the colloidal particles or are oxidizing compounds, which cause membrane fouling. Today, environmental legislations require new wastewater treatment technologies, which possess enhanced purification efficiency using less chemicals and producing fewer by-products. Advanced oxidation processes and ozone treatment meets these requirements, as they generate free radicals, which are able to react with the contaminants directly and indirectly, and finally decomposes to oxygen. In these reactions two typical pathways were observed, influencing membrane filtration parameters: (1) the micro-flocculating effect producing associated colloidal particles, and (2) degradation of organic materials (Fig.2.). The latter decreases the retention of pollutants and may increase the pore fouling. Short-term ozone pre-treatment leads to micro-flocculation, and results in large associations, thereby reducing membrane fouling [28, 29].

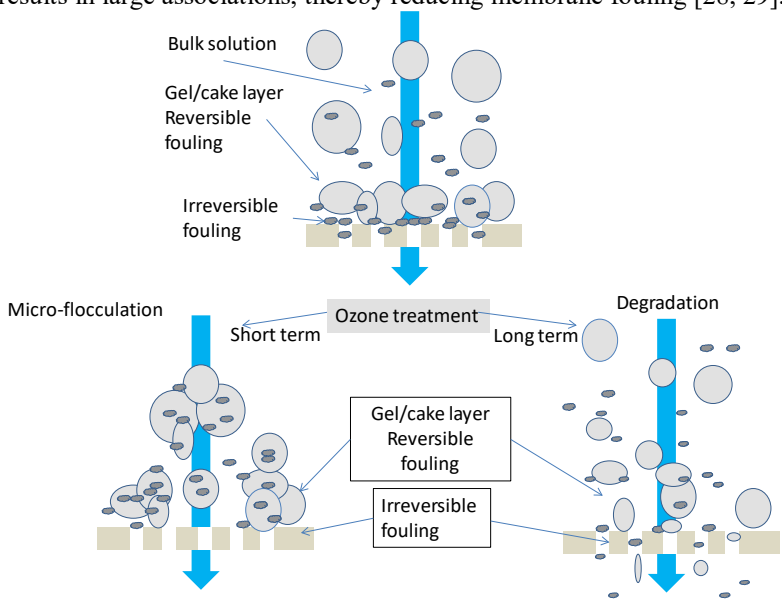

Figure 2. Possible effect of ozone pre-treatment on membrane filtration of dairy wastewaters

Laszlo et al. [30] investigated the applicability of membrane filtration (NF) in combination with preozonation in surfactant containing dairy wastewater treatment technology. The combination of preozonation and membrane filtration was able to reduce the surfactant content of the wastewater below the legally regulated limit. It was found that preozonation decreased the flux and increased the COD and surfactant removal efficiencies. Greatly enhanced biodegradability of the retentate also was observed. The explanation of these results may be related to the microflocculation effect of preozonation of organic matter and to reaction between the components present in dairy wastes, the ozonation by-products and metal ions e.g., calcium (present in considerable amount in dairy wastewaters) may preclude the formation of aggregates.
Several researchers have found that ozone pre-treatment increases the flux of effluents containing natural organic compounds, proteins, or oil emulsion [27, 31]. Ozone treatment oxidizes the molecules (double bonds or the aromatic rings are decomposed) – a number of oxidized functional group (-OH, = O and -COOH) appear on them. Negative surface charge of the colloidal particles is increased due to the acid-base balance of these carboxyl groups with water. This means that in case of hydrophobic membranes the role of Van der Waals interactions is suppressed, while in case of hydrophilic membranes the electrostatic repulsion increases between the negatively charged membrane and the particles – both reduces membrane fouling and finally increases flux [32]. Earlier studies showed that the ozone pre-treatment has changed the fouling mechanism due to microflocculation: instead of pore fouling reversible cake/gel layer appears, resulting in decreased irreversible filtration resistances and increased reversible resistances [29].
In order to avoid flux decline during filtration, the fouling mechanism should be modified; to this end it should be taken into account that coagulation of proteins, the reactions and decomposition of ozone are all strongly pH dependent. At higher pH the reaction rate of ozone decomposition is higher, while fouling is decreased. It also should be considered that the minerals of dairy wastewaters (mainly the calcium and magnesium ions) influence the size and stability of floccules, [27]; however, their role and mechanism of membrane filtration should be clarified.

4. CURRENT TRENDS AND QUESTIONS TO BE ANSWERED

Earlier studies indicate that preozonation may enhance the treatability of dairy wastewaters with membrane filtration. However, the industrial application requires further large scale experiments to optimize the ozone dosage and the ozonation time [33], moreover the clarification of exact mechanism of the oxidation reactions and its effects on membrane-solute interactions determining fouling is necessary.
In recent years, several methods were applied to characterize the fouling layer, especially the membrane-fouling layer interface, which has key importance in the design of pre-treatment and operational procedure, as well as optimization of cleaning processes of fouled membranes. Parameters of the membrane surface that affect fouling are hydrophilicity, roughness, charge, surface free energy and steric hindrance or repulsion. Besides methods based on physicochemical properties (zeta-potential, contact angle or surface free energy measurements) a range of techniques were applied to characterize membrane fouling layer, such as, scanning electron microscope (SEM), X-ray photoelectron spectroscopy (XPS) and infrared (IR) spectroscopy [34]. These methods may be powerful methods to obtain new information about the nature of membrane-foulant interactions, and by now only few publications can be found, which aim the investigation of the effect of pre-treatment on these parameters [20].

5. SUMMARY

Membrane processes used for the purification of dairy wastewaters containing proteins, carbohydrates, minerals, or detergents are studied. The applications of these processes in dairy industry are limited due to

membrane fouling. For more fundamental understanding of the mechanism of fouling and hence to develop appropriate methods which can prevent the membrane fouling the characterization of fouling is necessary. Combination of oxidation pre-treatment and membrane filtration is a promising method for purification of food industrial wastewaters, including dairy wastewaters, since previous results have shown that both the flux and the cleaning efficiency can be increased. However, to develop an industrial application of the process several issues need to be clarified, such as appropriate ozone dose, the operational parameters of ozone treatment, or the effect of pre-treatment on the interactions between the membrane-solvent-pollutant, which determine the membrane fouling mechanism.

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