ORIGINAL ARTICLE

Development of nutritious frozen dessert from fruit-fruit formulation: analysis of sensory and market survey

Fatin Nadzirah Zakaria*[a], Anis Sofea Abdul Malik[b], Nina Keterina Hashim[a], Razif Dasiman[a]

[a]Department of Basic Sciences, [b]Centre of Nutrition and Dietetics, Faculty of Health Sciences, Universiti Teknologi MARA (UiTM), UiTM Kampus Puncak Alam, 42300 Bandar Puncak Alam, Selangor, Malaysia.

***Corresponding Author**

Fatin Nadzirah Zakaria
Email: fatinn9604@uitm.edu.my

Abstract:

Nowadays, demands for the nutritious food keep increasing. Consumers need products that can provide good nutrients, low calories, high fiber and giving satisfaction feeling and well-being. Frozen dessert products have been consumed a long time ago. However, it does not yet been considered as a nutritious product as it always known as a food that consist of high sugar and fat content. Thus, innovations have been done by developing nutritious frozen dessert snack from dates (*Phoenix dactylifera*) and combined with two combinations of fruits that potentially have high antioxidant properties and enhance flavors, 1) Mango (*Mangiferaindica*) and papaya (*Carica papaya*); 2) Mango and orange (*Citrus sinensis*); 3) Mango and dragon fruit (*Hylocereuspolyrhizus*) which can be act as nutrient dense snack with zero added sugar. The proximate study was conducted which includes determination of carbohydrates, protein, fat, crude fiber, moisture, ash and energy. Hedonic test of the sensory evaluation was performed to evaluate the sensory characteristics between three different flavors of frozen dessert which include color, texture, taste, sweetness and overall acceptance. Market survey of developed product also was determined to predict the acceptance and likelihood consumer. This experimental study was conducted at UiTM Puncak Alam. The overall nutrition composition of frozen dessert showing a good nutritional value for all three flavors. For sensory evaluation, there was a significant differences ($p<0.05$) on color between three flavors. However, there were no significant differences ($p> 0.05$) on texture, taste, sweetness and overall acceptance. From the market survey, the results showed that 89.2 % of consumer stated that this frozen dessert is marketable. The nutritious frozen dessert are not just a sugar free dessert, but also as antioxidant booster, lactose free products and contain high nutritional values for all consumers.

Keywords: Dates, frozen dessert, fruits, market survey, proximate analysis, sensory evaluation

1. INTRODUCTION

Health is the important things in human life. In fact, food is like a central to human health. A good nutrition is important in development process, giving the optimal growth and prevention of disease. Recently, there is a growing concern about the changes in snacking habit. Unhealthy snack usually rich in sugar contents or saturated fats and absence of significant nutrient value [1]. Overweight and obesity issues had become one of the most serious public health concerns nowadays. It had revealed that nearly two third out of the Malaysian faced with this kind of health issue due to the unhealthy eating practice. According to National Health and Morbidity Survey, it indicates about 17% of Malaysian people had obesity and about over 40% had a problems with being overweight [2].

Demands for health oriented products are increased [3]. Consumer needs products that can provide them good nutrients such as low calories and high fiber as well as can giving the consumer a feeling of satisfaction and well-being [4]. The current recommendations had supports diet rich in fruits as foods that should be consume most often for healthy lifestyles [5]. However, in recent survey, it was revealed that the fruits consumption among Malaysian is still low than the amount recommended by the World Health Organizations [6].

Previous studied have been shown that, increased consumption of fruits could be an essential factors for a healthy diet in reducing the risk of chronic diseases [7]. Daily consumption of fruit is also highly recommended as it has a benefit of essential nutrients, health-promoting

phytochemical and a desirable taste and aroma [8]. Moreover, according to Abu-reidah et al., 2016, fruits are claimed to have a beneficial effect as it rich of antioxidants micronutrients such as vitamin C, carotenoids, minerals and polyphenols. Fruits also can act as a protective agent in order to protect body from any oxidative stress which come from reactive oxygen species (ROS). The increased of the antioxidants availability would prevent any cellular damage which are produced by endogenous ROS [10].

Frozen dessert products have been consumed by consumers a long time ago. However, it does not yet been considered as a nutritious product [11] due to its high calories intake, high fat content and high in sugar. Developing dessert by using fruits as a sugar substitutes can alter the sensory attributes of that products and can influence consumer liking. The utilization of sweetness which comes from fruits can be a wise strategy in order to reduce the uptake of added sugar when requiring a sweet taste. For this study, dates (*Phoenix dactylifera*) are used as a sugar substitute and an alternative natural sweetener which mainly containing of fructose, glucose, and sucrose. It also provides an excellent fiber source in creating healthy and nutritious snack. Interestingly, based on findings from Prapasuwannakul et al. [12], it has been reported that dates fruit have potent antioxidant and anti-mutagenic qualities which will give a numerous health benefits to human.

In addition, there is a limited research has been done in Malaysia related to consumption and nutrient content of healthy and nutritious snack in type of a frozen dessert which using a variety combinations of fruits. *Mangifera indica (mango)* is a rich source of carotenoids and produces high content of ascorbic acid and phenolic compounds that would act as antioxidant booster [13]. In enhancing the different color for attraction purposes and flavors, *Hylocereus polyrhizus* (dragon fruit), *Carica papaya* (papaya) and *Citrus sinensis* (orange) were also been used. These fruits were scientifically proven as a good source of antioxidant activity and provide health promoting values due to its polyphenols contents [13].

Therefore, this current research highlighting the developing of nutritious frozen dessert from fruit-fruit formulation that potentially gives good health benefits. This experimental study were divided into four phases ; 1) product development 2) proximate analysis for determination of nutrition value 3) sensory evaluation test to evaluate the likely and acceptance of developed product 4) market survey to determine the acceptability of the product in the market.

2. MATERIALS AND METHODS

2.1 Preparation of frozen dessert

The preparation of frozen dessert was carried out in the Food Preparation Lab, level 4, FSK 1, 5, UiTM PuncakAlam Campus. It was prepared by using a standardized recipe that had been optimized according to its ratio. The fresh fruits were used in preparation of frozen dessert and dates were used as a sugar substitutes. In order to produce 100 g of frozen dessert, the weight of fruits which has been used is 26.3 g, 47.4 g, and 26.3 g respectively for all flavors. The flow of the preparation in making a frozen dessert is shown in Figure 1.

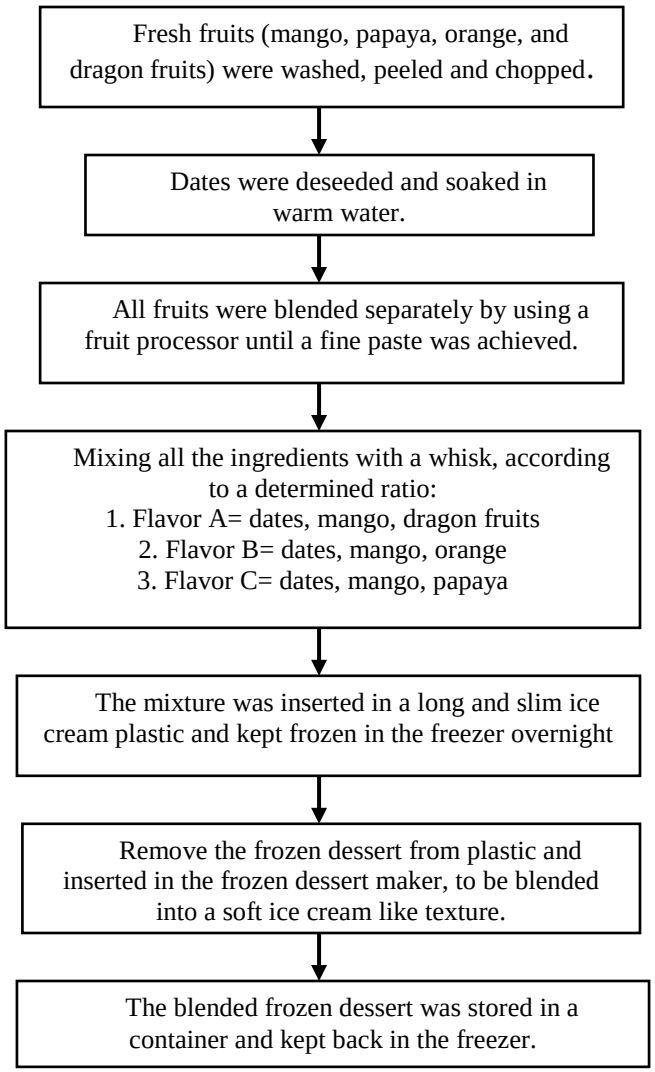

Figure 1: The preparation of nutritious frozen dessert from fruit-fruit formulation

2.2 Proximate analysis

The nutritional value of carbohydrate, protein, fat, ash, moisture, energy and fibre were determined using standardized protocol and formula.

2.3 Respondents

The study includes 35 panelists from Faculty of Health Sciences, UiTM Puncak Alam. The sensory evaluation and market survey were conducted to determine the acceptability

of the developed product. The panelists were asked to rate each sensory attributes and answering the questionnaire given for the market survey. They were separated into different cubicles and were prepared with three samples of developed products, sensory evaluation sheet (7-point hedonic scale) and a market survey questionnaire. The panelists who fulfilled all the inclusion and exclusion criteria were selected.

a) Inclusion criteria
   1. Age 20 years old and above.
   2. Target area: among FSK members.
   3. Able to read, write and understand the questionnaire.
   4. Pass the basic taste identification (able to differentiate between four basic taste)
   5. Non-color blind
   6. Availability of time to do the sensory and market survey test.

b) Exclusion criteria
   1. Respondents who are not feeling well (fever, coughing, flu)
   2. Respondents who are having ulcer in the mouth
   3. Respondents who are pregnant.

2.4 Sensory evaluation

The reliability of sensory evaluation results heavily depends on the ability of the sensory panelists. The hedonic test of sensory evaluation is attempted to assess the presence of statistically significances differences between the formulation of frozen fruit dessert from combinations of fruits with three different flavor concerning its color, aroma, taste, aftertaste and overall acceptance. It is used to determine the consumer preference or degree of liking or disliking toward a developed product. It was designed as in-house panels where panels can taste the sample of developed product through rating scales. The meaning for each scale is shown in Table 1.

Table 1: Rating scales for sensory evaluation

Rating Scale	Descriptions
1	Dislike very much
2	Dislike moderately
3	Dislike slightly
4	Neither like nor dislike
5	Like slightly
6	Like moderately
7	Like very much

2.5 Market survey analysis

Questionnaires were provided for the participants to answer all the questions given. These questionnaires were distributed after completion of sensory evaluation. Any questionnaire that was incomplete or filled incorrectly was excluded from this study.

2.6 Statistical analysis

All the data was analyzed by using Statistical Package for Social Science (SPSS). The sample of frozen dessert for proximate analysis was prepared three to four samples replicated measurement for each experimental unit. All the samples replication were collected for analytical data, expressed as a mean and standard deviation. For sensory evaluation, the data were analyzed by using Analysis of Variance (ANOVA) with Tukey-Honestly Significant Differences (HSD) multiple comparisons. A descriptive statistics was used for analyzed data of market survey in identifying the acceptability of the consumer towards the developed products.

3. RESULT AND DISCUSSION

3.1 Development of nutritious frozen dessert formulation

Three flavors were produced to create variety of choices for consumers especially children. The selection of fruits in nutritious frozen dessert was made under public acceptance, availability and antioxidant levels. It was made of a combination of fruits which are dates (*Phoenix dactylifera*), mango (*Mangifera indica*), papaya (*Carica papaya*), red dragon fruit (*Hylocereus polyrhizus*) and orange (*Citrus sinensis*). The amount of dates, mango and papaya/red dragon fruit/orange fruit in order to yield in 100 g of frozen dessert is 26.3 g, 47.4 g, and 26.3 g respectively (Figure 2).

Figure 2: The final product of the orange, dragon fruit and papaya flavored nutritious frozen dessert

3.2 Proximate analysis

The potential of a certain food to be highly consumed by the consumers is determined primarily by its nutrient value. High nutrient composition would give a value added factor towards a particular product. Figure 3 showed the nutritional composition of all the three flavors which were obtained through the proximate analysis. The major macronutrient present in the frozen desserts includes carbohydrate, protein and fat. The carbohydrate content are almost the same in three flavors, 25.7%, 25.8% and 26.7% respectively. It acts as a major source of energy in the body. These frozen desserts can be classified as sugar-free as there is no additional sugar used. The carbohydrate content and sweetness is majorly contributed by dates fruit. Dates has low glycemic index (GI). Thus, the chances of having hyperglycemia is lower [14]. The protein content does not vary much from each other as it shown in Figure 3.

Meanwhile, the fat content is the lowest for all three flavors because the fruits used have low content of fat. Therefore, one serving can be considered as fat-free. The ash content of frozen desserts is the amount of macronutrients such as minerals and vitamins present. Dragon fruit, orange and papaya flavors contain 2.2%, 2.1% and 2.3% respectively. The specific amount of each minerals or vitamins was not identified as it requires further analysis. Crude fiber is a method of measuring the quantity of indigestible cellulose materials in the foods mainly lignin and cellulose [15]. Among the three flavors, the papaya flavored frozen dessert has a slightly high value of crude fiber which is 0.8% as compared to the two others flavors. The randomized trial study stated by [16] shows that fibers have a beneficial role in insulin sensitivity, weight control and hyperlipidemia. It also helps in increasing the stool bulk and minimize the time for waste materials spends to remove out from the human body. Thus, by having a light snack of a nutritious frozen dessert for several times a day will increase the fruits intake together with fiber intake and enhance the prevention of certain diseases.

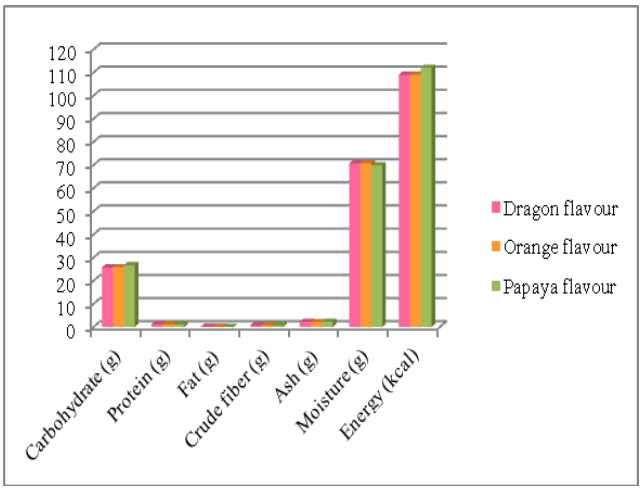

Figure 3: Nutrition composition of 100g nutritious frozen dessert

3.3 Sensory evaluation

In food industry service, the idea of forming functional foods is becomes more popular. Functional food can be defined where the foods is providing an additional physiological benefit beyond basic nutritional value and are fundamental for survival [17]. However, the quality of food must be appealing, appetizing and specifically the eating quality attributes such as color, texture, taste, aroma and overall acceptance of certain foods is acceptable to consumer. The sensory features of colors are plays an important role in improving the consumer preference towards a products. Among the three samples (Figure 4), the dragon fruit flavored frozen dessert was evaluated with high score (6.46 $\pm$ 0.691) compared to the orange flavored (4.54 $\pm$ 1.325) and papaya flavor (4.35 $\pm$ 1.567) of frozen dessert. This may due to the color of dragon fruit itself where it comes from natural pigments known as hylocerenin and isohylocerenin that gives natural florescent property [18]. Other sensory characteristic that had been evaluated is the texture of frozen dessert formulation. Texture attribute is very complex as it is related to the physical condition and structure of food sample which is detected visually, auditory and touch [19]. In this study, there was no significant difference of texture for three different samples of frozen dessert ($p > 0.05$). The texture of frozen dessert was reported to be smooth. According to Manickavasagan and Mathew [20], it was stated that by replacing white sugar with date syrup, it will produced a similar texture and acceptance rating to that food products. On the other hand, there was also no significant difference on taste sensory attribute and sweetness in the frozen dessert formulation ($p>0.05$). These results proved that dates fruits have a great potential as a sugar substitute and enhance the sweetness of flavors for frozen dessert formulations.

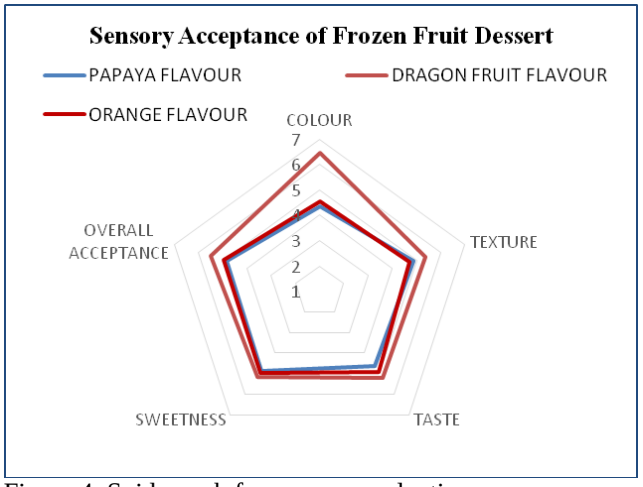

Figure 4: Spider web for sensory evaluation

3.4 Market survey

The development of functional food nowadays was quite challenging as it has to meet the consumer's expectations for products that are simultaneously palatable, nutritious and healthy [21]. From the market survey form (Table 2), the consumers were asked regarding the marketability of nutritious frozen dessert products. Based on the results, it shown about 89.2% of the consumers stated that, this nutritious frozen product is marketable as this product is very good in providing additional physiological benefit beyond basic nutritional requirements. A good nutrition value is important to human health [22] as it would provide an optimal growth and development and prevent from any disease [23]. The selection of base products and nutrition information strategies had strongly associates with the acceptance of functional food in the market [24-25].

Table 2: Market survey of the consumer towards the developed products

Characteristics	Number of respondents (n)	Percent (%)
Do you ever purchase frozen dessert?		
Yes	34	91.9
No	3	8.1
If yes, where do you usually buy or purchase frozen dessert?		
Minimarket	7	17.1
Supermarket	26	63.4
24 hours store	8	19.5
How often do you purchase frozen dessert?		
Daily	3	8.1
Weekly	8	21.6
Monthly	26	70.3
If you were to purchase this product, what would you be willing to pay?		
< RM 5	19	51.4
RM 6 – RM 10	18	48.6
What features do you consider when purchasing frozen dessert?		
Nutrition label	12	16.9
Price	15	21.1
Flavors	31	43.7
Ingredients	10	14.1
Packaging	3	4.2
Do you think this products something people need or want?		
Need	7	18.9
Want	20	54.1
Both	10	27.0
When you are considering new products in the market, what are the things you generally considered?		
Price	16	27.1
Nutritional value	15	25.4
Brand	4	6.8
Innovation	5	8.5
Quality	19	32.2
Do you think this new product of Frozen Dessert from Fruit Formulation is marketable?		
Yes	33	89.2
No	4	9.8

4. CONCLUSION

The result of the present study goes to emphasis that this nutritious frozen dessert was not only sugar free dessert, but also as antioxidant booster, lactose free and consist of high nutritional values for all consumer. Thus, efforts need to be made in order to increase the value and interest towards the developed products in order for its utilization and commercialization.

ACKNOWLEDGEMENTS

This research was funded by Centre of Dietetics, Faculty of Health Sciences, UiTM Puncak Alam and all the works was done at Food Preparation Lab and Sensory Lab, UiTM Puncak Alam.

REFERENCES

[1] Hendy, H.M., Williams, K.E. & Camise, T.S. "Kid ' s choice program improves weight management behaviors and weight status in school children", *Appetite*, *56*(2): 484–494, 2011.

[2] National Health and Morbidity Survey, "Non communicable diseases, risk factors and other health problem", 2015.

[3] Ben Jeddou, K., Bouaziz, F. A. pd., Zouari-Ellouzi, S., Chaari, F., Ellouz-Chaabouni, S., Ellouz-Ghorbel, R., & Nouri-Ellouz, O., "Improvement of texture and sensory properties of cakes by addition of potato peel powder with high level of dietary fiber and protein", *Food Chemistry*, *217*: 668–677, 2017.

[4] Demand, I., Savi, M., "Consumption and Industrial Demand for Fruit Juices and Concentrates", *Agricultural Economics*, *381*(0): 589–597, 2010.

[5] Holmes, B., Habi-rachedi, F., Trotin, B., Paineau, D., Guyonnet, D., Rondeau, P., Whelan, K., Flouri, B., "Dietary patterns , digestive symptoms , and health-related quality of life in women reporting minor digestive symptoms", *Nutrition*, *35*: 132–138, 2017.

[6] Khairunnisa, I.O. et al., "Consumption pattern on fruits and vegetables among adults: a case of Malaysia", *Academic Journal of Interdisciplinary Studies*, *2*(8): 424–430, 2013.

[7] Miller, L.M.S., Cassady, D.L., "The Effects of nutrition knowledge on food label use. a review of the literature", *Appetite*, *92*: 207–216, 2016.

[8] Kiat, S., Alasalvar, C., Shahidi, F., "Review of Dried Fruits : Phytochemicals , Antioxidant Efficacies, and Health Benefits", *Journal of Functional Foods*, *21*: 113–132, 2016.

[9] Abu-reidah, I.M., Gil-izquierdo, Á., Medina, S., Ferreres, F., "Phenolic Composition Profiling of Different edible Parts and By-Products of Date Palm (Phoenix Dactylifera L.) by using HPLC-DAD-ESI / MSn", *Food Research International*, *100*: 494–500, 2016.

[10] Kirschweng, B., Tatraaljai, D., Foldes, E., Pukanszky, B., "Natural antioxidants as stabilizers for polymers", *Polymer Degradation and Stability*, 2017.

[11] Doyle, I.M.P., Dale, G., Choi, H., City, B., "Nutritional frozen dessert and methods of manufacture", *Food Chemistry*, 2012.

[12] Prapasuwannakul, N., Nathong, S., Nirami, W., Bussaban, K., "The Use of Date Flesh as Sugar Substitute in Cracker", *In food science* (pp. 8–11), 2016.

[13] Rana, J., Paul, J., "Consumer behavior and purchase intention for organic food: a review and research agenda", *Journal of Retainling and Consumer Services*, *38*(February): 157–165, 2017.

[14] Varela, P., Pintor, A., Fiszman, S., "How hydrocolloids affect the temporal oral perception of ice cream", *Food Hydrocolloids*, *36*: 220–228, 2014.

[15] Singh-Ackbarali, D., Maharaj, R., "Sensory evaluation as a tool in determining acceptability of innovative products developed by undergraduate students in food science and technology at The University of Trinidad and Tobago", *Journal of Curriculum and Teaching*, *3*(1): 10, 2014.

[16] Cli, M.A., Toivonen, P.M.A., "postharvest biology and technology sensory and quality characteristics of "Ambrosia" apples in relation to harvest maturity for fruit stored up to eight months", *Postharvest Biology and Technology Journal*, *132*(June): 145–153, 2017.

[17] Peng, C.J., Lee, M.S., Wahlqvist, M.L., Pan, W.H., Lee, W.C., Lin, C., Guo, H.R., "Needs-Based Food and Nutrient Security indices to monitor and modify the food supply and intakes: Taiwan, 1991-2010", *Food Policy*, *57*: 142–152, 2015.

[18] Perche, O., Vergnaud-Gauduchon, J., Morand, C., Dubray, C., Mazur, A., Vasson, M.P., "Orange juice and its major polyphenol hesperidin consumption do not induce immunomodulation in healthy well-nourished humans", *Clinical Nutrition*, *33*(1): 130–135, 2014.
[19] Balázs, S.P., "Sensory Evaluation in Food Industry", 2012.
[20] Manickavasagan, A., Mathew, T.A., "Dates as a substitute for added sugar in traditional foods – a case study with Idli", *J. Food Agriculture*, *25*(11): 899–906, 2013.
[21] Granato, D., Branco, G.F., Cruz, A.G., Faria, J. de A. F., Shah, N.P., "Probiotic dairy products as functional foods", *Comprehensive Reviews in Food Science and Food Safety*, *9*(5): 455–470, 2010.
[22] Ji, Y., Du, X., Okazaki, Y., Hori, M., Yamanaka, K., Mori, Y., "Risk behaviors and its association with caries activity and dental caries in Japanese children", *Pediatric Dental Journal*, *16*(1): 91–95, 2006.
[23] Kokila, T., Ramesh, P.S., Geetha, D., "Ecotoxicology and environmental safety biosynthesis of AgNPs using carica papaya peel extract and evaluation of its antioxidant and antimicrobial Activities", *Ecotoxicology and Environmental Safety*, *134*: 467–473, 2016.
[24] Bruschi, V., Teuber, R., Dolgopolova, I., "Acceptance and willingness to pay for health-enhancing bakery products – empirical evidence for young urban Russian consumers", *46*: 79–91, 2015.
[25] Bublitz, M.G., Peracchio, L.A., "Applying industry practices to promote healthy foods: an exploration of positive marketing outcomes", *Journal of Business Research*, *68*(12): 2484–2493, 2015.