

# Well tasting, meat protein enriched meals for healthy ageing

Susanne Støier<sup>1</sup>, Erik T. Hansen<sup>2</sup> and Lene Meinert<sup>1</sup>

<sup>1</sup>DMRI Danish Technological Institute, 2630 Taastrup, Denmark

<sup>2</sup>DC Ingredients, Randers, Denmark

**Abstract – Life expectancy is increasing and the population of elderly is growing. A sufficient protein intake plays a central role in relation to healthy ageing including maintenance of muscle function and prevention of sarcopenia. To meet with this need, well tasting products with a high content of quality protein are required. The aim of this investigation was to develop an appetizing high protein meal obtained by addition of pork and beef hydrolysates. Dishes of meatballs boosted with hydrolysed meat derived protein and served with soup was chosen for the test. According to a consumer study, overall liking was not affected by the addition of hydrolyzed pork or beef to the meatballs. On average, the consumers perceived the ready-to-eat-meal of soup with meat protein enriched meatballs as nutritional, healthy, a good choice for extra protein and suitable for people above the age of 65. It seems possible to use pork and beef hydrolysates for protein enrichment of meals and meat products.**

**Key Words – hydrolysates, nutritious, tasteful.**

## I. INTRODUCTION

From 1990 to 2011, life expectancy at birth has increased globally by 6 years, and in 2011 life expectancy was on average 70 years [1]. In the western countries, e.g. Denmark, life expectancy at birth was 79.9 years in 2014 [2]. Consequently, the population of elderly (> 65 years of age) as well as their life expectancy is increasing, making them an important consumer group with a great market potential. Elderly people may suffer from or are prone to develop sarcopenia [3]. Sarcopenia is defined as a condition with low muscle mass and reduced muscle strength and function. To prevent sarcopenia, the recommendation is exercise and a high protein diet. However, elderly people often experience reduced appetite and due to lower levels of physical activity and basal metabolism as well, their energy requirement is reduced, and the nutritional value of their diet becomes even more important. Therefore, it is of the utmost importance that products targeting the elderly population is well tasting, easy to eat and with a low degree of

satiation. By boosting a product with meat protein e.g. hydrolyzed pork or beef, the actual amount of food that needs to be consumed is not significantly increased. Furthermore, this supports the idea of muscle-to-muscle. However, a challenge is that hydrolyzed pork and beef may have a bitter and chemical taste due to the hydrolysis process resulting in smaller peptides – the smaller the peptides, the bitter the taste becomes [4]. The effort to optimize flavour due to the bitterness has to be taken into account when hydrolysates are added to products. Furthermore, the possibility of claiming protein enrichment of the product is of importance. EFSA has approved the following claim regarding protein and muscle mass: *Protein contributes to maintenance of muscle mass*. The claim can be used if the food product is a source of protein [5]. Food is considered a ‘*source of protein*’ and ‘*high protein*’ when at least 12% and 20%, respectively, of the energy value of the food is provided by protein [6]. The aim was to develop a well tasting meal based on high meat protein obtained by addition of pork and/or beef hydrolysates targeting the population of elderly (> 65 years of age). The objective of the study was to examine attitudes and hedonic responses of the elderly consumers towards the meat product with a high protein content. The hypothesis was that it would be possible to develop a meal, which was perceived as healthy and appetizing by the target group and at the same time considered as a ‘source of protein’.

## II. MATERIALS AND METHODS

### *Meat products*

Meatballs with pork and beef hydrolysates added as a spray-dried powder were developed. Four prototypes of each meat product (beef or pork) were used including different levels of hydrolysates (0%, 7%, 11% and 15%). The source of hydrolyzed protein matched the type of meat used – pork hydrolysates for pork meatballs and beef hydrolysates for beef meatballs. To cover the bitterness of the hydrolysates, spices and chili were added to the meatballs. The concept of the meat

product was a ready-to-eat soup with meatballs. The pork meatballs were served with a pumpkin soup while the beef meatballs were served with a tomato soup.

#### Nutritional composition

The energy and the nutritional composition of soups with meatballs are presented in Table 1 (beef) and 2 (pork).

Table 1. Nutritional composition\* of the tomato soup with beef meatballs. Hb = hydrolyzed beef.

	Nutritional composition per serving**			
	0 % hb	7% hb	11 % hb	15% hb
Energy (kJ)	1014	1112	1167	1235
Fat (E%)	25	23	22	21
Carbohydrate (E%)	42	38	36	34
Protein (E%)	30	36	39	42
Fibre (E%)	3	3	3	3

\* Generated with Nutrition calculation programme

\*\* 200 g soup + 100 g meatballs

Table 2. Nutritional composition\* of the pumpkin soup with pork meatballs. Hp = hydrolyzed pork.

	Nutritional composition per serving**			
	0 % hp	7% hp	11 % hp	15% hp
Energy (kJ)	1029	1127	1182	1250
Fat (E%)	22	23	22	20
Carbohydrate (E%)	46	38	36	34
Protein (E%)	31	37	39	42
Fibre (E%)	3	3	3	3

\* Generated with Nutrition calculation programme

\*\* 200 g soup + 100 g meatballs

The protein level of the products increases the more hydrolysates are added. Even without addition of hydrolysates, the products can be claimed as 'high protein' and the '*protein contributes to maintenance of muscle mass*' can be used as a statement.

#### Consumer test

A questionnaire to be used for the consumer test of the meat products was designed. First part of the questionnaire was dedicated to the sensory evaluation of the meatballs; second part consisted of a description of the main characteristics of the product as well as appropriateness ratings for a series of statements with the aim to elicit the consumers' opinion of the product on a cognitive level. Last part of the questionnaire was demographic information.

The consumer study was conducted in a shopping centre in the city of Copenhagen, Denmark. 103 subjects were included in the study (51 consumers for pork and 52 consumers for beef). The age of the participants was from 46 to 89 years of age (age intervals: 46-56 = 5.6%; 55-64 = 37.1%; 65-89 = 57.3%).

The samples (meatballs and soup) were served in plastic cups of 96 ml and were blind labelled with a three-digit code.

#### Hedonic and sensory evaluation

After agreeing to take part, participants were asked to complete the questionnaire. Each consumer had to taste and rate all four prototypes of one product, either pork or beef. In order to minimize carry-over and position effects, the serving of the samples was balanced and followed a monadic sequence [7]. To rinse the mouth after tasting each sample, sparkling water was given to the participants.

First of all, the participants had to rate the liking of the product, the liking of the meatballs' texture and the liking of the soup's texture on a 9-point hedonic scale. Afterwards, they had to answer CATA-questions (Check All That Apply). The questionnaire included a predetermined list of 15 descriptors, and each participant had to indicate all the sensory attributes that were appropriate for describing the product. The sequence of CATA attributes was randomized to reduce the possible effect of the descriptors' order on the sensory profile.

#### Appropriateness ratings

Appropriateness statements were given, and the participants had to rate how much they agree or disagree with each statement (e.g. I think this product is: A good choice for people in need of extra protein) on a 7 point scale, 1 = I totally disagree and 7 = I totally agree.

Finally, some demographic information was collected.

#### Data analysis

The hedonic results were analysed using repeated-measures ANOVA. The appropriateness ratings were analysed with one-way analysis of variance (one way ANOVA). Furthermore, multivariate data analysis was performed using Unscrambler X, version 10.2 (CAMO, ASA, Norway). The data from pork and beef products were treated separately.

A preliminary biplot with both the samples and the sensory descriptors in the matrix was performed in order to obtain an overview of the sensory properties of the prototypes.

### III. RESULTS AND DISCUSSION

#### *Demographic data*

Two thirds of the consumers were females, and the average age of the consumers was 66 years. Almost all of the consumers found it important to eat healthy, but only 38% of the participants would buy a product with the statement that it can help maintain muscle mass. 44% of the consumers did not see themselves in the target group for a product that helps maintaining muscle mass.

#### *Hedonic ratings*

The results of the hedonic evaluation of beef and pork products are shown in Table 3 (beef) and 4 (pork).

Table 3. Average liking scores of tomato soup with beef meatballs using a 9-point scale

Beef	Beef hydrolysate added				P-values
	0%	7%	11%	15%	
Overall liking	6.3 <sup>a</sup>	6.0 <sup>a</sup>	6.2 <sup>a</sup>	6.5 <sup>a</sup>	0.12
Texture of soup	6.5 <sup>a</sup>	6.4 <sup>a</sup>	6.5 <sup>a</sup>	6.6 <sup>a</sup>	0.79
Texture of meatballs	5.4 <sup>a</sup>	5.7 <sup>ab</sup>	5.7 <sup>a</sup>	6.1 <sup>b</sup>	<0.05

Table 4. Average liking scores of pumpkin soup with pork meatballs using a 9-point scale

Pork	Pork hydrolysate added				P-values
	0%	7%	11%	15%	
Overall liking	5.4 <sup>a</sup>	5.7 <sup>a</sup>	5.7 <sup>a</sup>	5.8 <sup>a</sup>	0.29
Texture of soup	6.0 <sup>a</sup>	6.4 <sup>a</sup>	6.3 <sup>a</sup>	6.4 <sup>a</sup>	0.11
Texture of meatballs	5.2 <sup>a</sup>	5.6 <sup>b</sup>	6.0 <sup>b</sup>	5.9 <sup>b</sup>	<0.05

There were no significant differences between neither the beef nor the pork products regarding overall liking. Addition of up to 15% hydrolysate in the meatballs did not affect the consumer liking of the products. As expected, there was no difference in the rating of the texture of the soup base. An increased amount of added hydrolysate resulted in a higher rating of texture of the meatballs. It seems that hydrolysates as a spray dried powder can be

added to the products without affecting the hedonic properties negatively. It even improved the liking of the texture of the meatballs. The overall liking was measured on the product in general and not separately on soup and meatballs. Therefore, it is unknown if a given liking score is determined by the meatballs or the soup or the combination of the soup and meatballs.

Sample variation of the beef products is mainly explained by the sensory attributes soft or firm texture (meatballs), while the sample variation of the pork products is explained by soft and firm texture as well and spicy/herbal.

#### *Appropriateness rating*

In average, most answers were rated 3, 4 or 5 and therefore close to a neutral answer (Table 5). To some extent, the products were described as practical, nutritional, healthy, a good choice for extra protein and suitable for people above the age of 65. Additionally, the products were not found to be artificial. It was not possible to make a clear statement of whether the products were appetizing, tasty or something they would like to eat and buy. No significant differences between pork and beef were found in the appropriateness questions. It would probably be beneficial to claim the product with the statement that 'protein contributes to maintenance of muscle mass'.

Table 5. Mean appropriateness ratings and standard deviation for pork and beef.

	Pork		Beef	
	Mean	SD	Mean	SD
Appetizing	4.0	1.7	4.3	1.7
Unsuitable for 60+	2.9	1.8	2.5	1.7
High quality	4.3	1.7	4.3	1.5
Tasty	4.0	1.8	4.3	1.6
Practical	4.6	1.6	4.4	1.5
Like to eat	3.9	2.0	4.0	2.0
Regular consumption	3.6	1.8	3.9	1.9
Not want to buy	3.5	2.2	3.4	2.1
Good choice for extra protein	4.7	1.4	5.0	1.4
Nutritional	4.7	1.6	4.8	1.4
Unhealthy	2.8	1.7	2.5	1.6
Artificial	3.4	2.0	3.1	1.8

### IV. CONCLUSION

The results of the hedonic test indicate that addition of up to 15% hydrolysate in the meatballs did not affect overall liking and even improved texture of

the meatballs. Overall liking scores ranged from 5.4 to 5.8 for pork and from 6.0 to 6.5 for beef.

The appropriateness questions were in average rated more or less neutral.

Further product development is needed in order to increase the liking of the soup with meatballs.

## ACKNOWLEDGEMENTS

This research was supported by The Pig Levy Fund and The Cattle Levy Fund. Authors thank Ida Steen, Konstantina Sfyra, Marie Ahlburg and Niki Alexi (students at Copenhagen University), who have done an excellent work with the investigations.

## REFERENCES

1. World Health Organization
2. OECD,  
<http://www.oecdbetterlifeindex.org/countries/denmark>. Retrieved 15.04.2015
3. Castillo, E.M., Goodman-Gruen, D., Kritz-Silverstein, D., Morton, D.J., Wingard, D.L. & Barrett-Connor, E. (2003). Sarcopenia in elderly men and women: the Rancho Bernardo study. *American journal of preventive medicine*, **25**, 226-231.
4. Sun, X.D. (2011) Enzymatic hydrolysis of soy proteins and the hydrolysates utilisation. *International Journal of Food Science & Technology*, **46**, 2447-2459.
5. EU Register on nutrition and health claims. <http://ec.europa.eu/nuhclaims/?event=search&CFID=1623386&CFTOKEN=7f8d7372128fb691-BE54D892-A92F-B4B2-D884122170D20A3B&jsessionid=9212f69faeb641d8e9b7654868165e18a4d2TR> Accessed 15.04.15
6. Commission, E. (2007) Regulation (EC) No 1924/2006 of the European Parliament and of the Council of 20 December 2006 on nutrition and health claims made on foods. *Official Journal of the European Union*.
7. MacFie, H., Bratchell, N., Greenhoff, K. & Vallis, L. (1989) Designs to balance the effect of order of presentation and first-order carry-over effects in hall tests. *Journal of sensory studies*, **4**, 129-148.