Análisis sensorial y perfil de textura de chorizo utilizando mezclas de carne de conejo y proteína de soya texturizada

Sensory analysis and texture profile of chorizo using blends of rabbit meat and textured soybean protein

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Resumen

La utilización de carne de conejo en productos procesados es baja. Sin embargo, el chorizo elaborado con carne de conejo puede ser una opción para incrementar el mercado de este tipo de carne. El objetivo de este estudio fue determinar el efecto de mezclar proteína de soya texturizada y carne de conejo sobre el perfil de textura y propiedades sensoriales de chorizo. Se utilizaron cinco tratamientos, un control y cuatro con mezclas de carne de conejo y soya texturizada en proporciones de 10, 20, 30 y 40%. Se midió actividad de agua, análisis de perfil de textura, color y se llevó a cabo una prueba sensorial al final del experimento de cuatro de los tratamientos. Los resultados indican que la A_w y pH disminuyeron ($p<0.05$), mientras que el valor de b* se incrementa con el

tiempo de almacenamiento (p<0.05). El valor de L* disminuyó después de 7 d de empacados al vacío, pero se incrementó al día 14. El tratamiento con 20% de proteína de soya texturizada presentó menor dureza y más elasticidad que el tratamiento control. El análisis sensorial indica que no existen diferencias significativas en olor global entre todos los tratamientos (p>0.05), pero en color, dureza y sabor fueron diferentes (p<0.05). En conclusión, la proteína de soya texturizada puede ser mezclada con carne de conejo para procesar chorizo. En conclusión, la proteína de soya texturizada puede ser mezclada con carne de conejo para procesar chorizo. El producto cárnico obtenido tiene características sensoriales, perfil de textura, A_w y color aceptable para este tipo de embutidos crudos, especialmente en las mezclas con 20 y 30% de proteína de soya texturizada. Además, la mezcla de estos dos ingredientes cárnicos mejora las propiedades nutricionales y podría ofrecer un producto cárnico funcional.

Palabras clave: carne de conejo; chorizo; soya texturizada; análisis sensorial

Abstract

Rabbit meat usage in processed products is low. However, rabbit meat raw sausage can be an alternative to increase this meat's market share. The objective of this study was to determine the effect of blending textured soybean protein and rabbit meat on the texture profile analysis and sensory properties of the chorizo. Five treatments were designed, one control and another four using blends of rabbit meat and textured soybean in ratios of 10, 20, 30 and 40%. Measurements were water activity, texture profile analysis, and color, while a sensory test was conducted at the end of experiments for four treatments. The main results indicate that A_w and pH values decreased (p< 0.05), while b* value increased with storage time (p<0.05). L* value decreased after 7 d vacuum packing, but then increased after 14 d. Treatment with 20% of textured soybean results in less hardness and more springiness. Sensory analysis indicates that there is not significant difference in odor global appearance in all treatments (p>0.05), but color, hardness and taste were different (p<0.05). In conclusion, textured soybean protein can be blended with rabbit meat for processing chorizo. The meat product obtained has sensorial characteristics, a texture profile, A_w and color acceptable for this kind of raw sausage, especially in blends with 20 and 30% of textured soybean protein. Moreover, the blend of these two meat ingredients improved nutritional properties and could therefore be offering as a functional meat product.

Keywords: rabbit meat; raw sausage; textured soybean; sensory analysis

Introduction

The Mexican chorizo is a raw sausage made by mixing meat, fat and spices that do not require intentional ripening (González-Tenorio *et al*., 2013). This raw sausage is made using traditional processes by small producers who sell directly to consumers and to large companies that distribute their product through supermarket chains, which means that there are differences regarding product quality (González-Tenorio *et al*., 2012). Rabbit meat is considered as a lean meat that has a different nutritional profile from other meats, and is characterized by its easy digestion, low concentrations of fat, cholesterol and sodium (Para *et al*., 2015). Additionally, studies have shown it also contains several physicochemical characteristics superior to other meats, such as pH, water holding capacity, color and texture (Chodová & Tumová, 2013; Dalle Zotte *et al*., 2016).

Textured soybean is used in meat products as an extender to use a low-cost protein source (Singh *et al*., 2008). Textured soybean is obtained from the extrusion of flour or protein concentrates of soybean that once hydrated and cooked, is known to absorb up to three times its weight (Asgar *et al*., 2010). This type of soybean is perceived as a healthy ingredient as it is cholesterol free and has a low fat and calorie content (Orcutt *et al*., 2006; Singh *et al*., 2008). The use of textured soybeans can be incorporated into a meat product from 1.5 up to 100%, to obtain analogous products (Omwamba *et al*., 2014). With these levels, an increase in the product's water retention has been observed (Yadav *et al*., 2013), improving the protein content (Londero *et al*., 2015) and decreasing water loss (Gök *et al*., 2012; Yadav *et al*., 2013). However, a decrease in taste and other sensory attributes in low fat meat products have been observed (Gök *et al*., 2012; Jalal *et al*., 2013; Carvalho *et al*., 2017).

Textured soybean has several benefits, such as control of bitter flavors, appropriate homogenization with other ingredients including colorants, chemicals or other additives (Singh *et*

al., 2008). Malav *et al*. (2015) mentioned textured vegetable protein can be used as meat extenders. It is also important to highlight the nutritional benefits, as textured soybean retains about 50% of isoflavones, and is a good source of minerals and vitamins (Hoogenkamp, 2004).

Blends of textured soybean protein and rabbit meat are appealing given that the former improves physical and nutritive characteristics of the product, and latter has nutritional properties and is recognized as a functional food. However, the effect of this combination on the sensorial and physicochemical aspects of raw sausage is unknown. Therefore, the objective of this study was to determine the effect of blending textured soybean protein and rabbit meat on the texture profile analysis and sensory properties of the chorizo.

Materials and methods

Raw Materials

The ingredients used for processing the raw sausage using rabbit meat were obtained in a store specializing in the distribution of ingredients for the meat industry. The formula for making raw sausage can be seen in Table 1. Rabbit meat was obtained from adult animals from the rabbit experimental station at the *Instituto de Ciencias Agropecuarias* located in Tulancingo, Hidalgo, Mexico. Meat was ground using a 6 mm perforated disc attached to a meat grinder (Torrey, Mexico).

Table 1. Raw sausage processed with rabbit meat added with textured soybean.

Ingredients	Treatments				
	T1	T2	T3	T4	T5
Rabbit meat (%)	100	90	80	70	60
Textured soybean (%)	0	10	20	30	40

Seasoning (g/kg)	55	55	55	55	55

Experimental design

A one-way experimental design was used for this study. Five treatments were obtained: One control without the addition of textured soybean and then four other treatments with 10, 20, 30 and 40% of textured soybean (Three batches were processed individually). Once the raw sausage was made, the chorizo was left to aerate for 18 hours before being packed in vacuum bags, and the monitoring of A_w, pH and color were started. The measurement of these variables was carried out on day 0, 7 and 14. A texture profile and sensory analysis was achieved on chorizo after 14 days of storage in refrigeration at 4 °C. For this purpose, a ranking test was used to evaluate the attributes of color, odor, taste, hardness and global appreciation (compare characteristics of a commercial chorizo, firm appearance, shape and uniform color).

Water activity, color and texture profile analysis

To determine the physical quality of the raw sausage added with texturized soybean, pH was determined by using a pHmeter (Hanna Instruments, Romania), the water activity (A_w) was determined using Aqua Lab 3TE equipment (Decagon Devices, Inc., Pulman, WA, USA) as well as MicrOptix i-LAB VRV-300 Handheld Visible Analyzing Spectrophotometer with D65 illuminant and 2° observer. Texture was measured using a CT3 texture analyzer (Brookfield, Middleboro, MA, USA) to perform the texture profile analysis (TPA). The measurement conditions were as follows: A sample of chorizo measuring 1cm each side was prepared, which was placed on the horizontal base of the equipment and compressed twice with a one-second interval, while head speed during the test was 1 mm/s, axially compressed to 50% of their original height. From the resulting charts the following attributes were calculated: Hardness (the maximum force during

the first compression), cohesiveness (ratio of the area of the second to first peak), springiness (sample recovered after the first compression), resilience (ratio of upstroke energy to downstroke energy during first compression) and adhesiveness (negative work between the two cycles).

Sensory evaluation

A ranking test was used to evaluate the sensory analysis of the raw sausages (UNE-ISO-8587, 2010). Eighteen panelists, all university students (12 women and 6 men, aged 18-24) were selected and trained according to general guidelines UNE-87024-1, 1995. The sensorial attributes evaluated in four treatments were color, odor, taste, hardness and overall appreciation, with 1 indicating the least intensity and 5 the highest intensity.

Statistical analysis

For the variables of physical quality, an analysis of variance was performed using repeated measures. A texture profile analysis was analyzed using a one-way analysis of variance. The sensory analysis was carried out based on the standard UNE ISO 8587 of the ordering test, using the Friedman non-parametric test and the Tukey test to establish significant differences ($P < 0.05$). All analyses were performed using three replicates by treatment. All analysis was carried out using SAS software.

Results

Water activity of chorizo blends of rabbit meat and textured soybean

The results of A_w of rabbit meat raw sausage added with texturized soybean are shown in Table 2. A_w values decreased with time ($p<0.05$) only in treatment one (T1), all other treatment there was no difference significative over time ($p>0.05$) with the other treatments. Vacuum packing raw sausage a few hours after processing causes the A_w to remain practically intact, there is little loss of water by packing the raw sausage using an oxygen barrier bag. However, the A_w in T1 after 14 d of packing was lower than other treatments, which was probably due to the textured soybean protein´s ability to hold water inside of the chorizo, Porcella *et al*. (2001) observed that soybean protein isolate was able to decrease drip losses in packed vacuum chorizos. The raw sausage rabbit meat product was desiccated after 14 d and A_w was lower.

Table 2. Quality of rabbit meat raw sausage added with textured soybean.

Treat	Day	A_w	pH	L*	a*	b*	C	h
	0	0.937[a]	5.19[a]	45.62[a]	12.56[a]	7.65[c]	15.53[b]	0.35[b]
T1	7	0.934[a]	5.11[a]	41.87[b]	11.66[b]	20.89[b]	24.01[a]	0.58[a]
	14	0.625[b]	4.82[b]	48.79[a]	12.98[a]	28.49[a]	31.34[a]	0.64[a]
	0	0.946[a]	5.22[a]	45.89[a]	11.49[b]	10.95[c]	15.98[b]	0.35[b]
T2	7	0.935[a]	5.05[a]	42.79[b]	13.10[a]	20.94[b]	24.83[a]	0.58[a]
	14	0.939[a]	4.66[b]	48.16[a]	13.99[a]	26.27[a]	29.93[a]	0.62[a]
	0	0.954[a]	5.36[a]	46.94[a]	14.48[a]	5.34[c]	15.51[b]	0.33[b]
T3	7	0.949[a]	5.20[a]	44.49[b]	12.78[c]	22.13[b]	25.64[a]	0.58[a]
	14	0.934[a]	4.66[b]	48.43[a]	13.62[b]	27.58[a]	46.16[a]	0.63[a]
	0	0.957[a]	5.39[a]	48.07[a]	10.93[b]	17.29[c]	20.73[b]	0.43[b]
	7	0.945[a]	4.81[b]	46.95[b]	13.53[a]	25.16[b]	28.64[a]	0.61[a]
T4	14	0.929[a]	4.76[b]	48.08[a]	12.83[a]	24.76[a]	27.61[a]	0.86[a]
	0	0.963[a]	5.44[a]	48.06[a]	10.12[c]	17.93[c]	21.31[b]	0.44[b]
T5	7	0.932[a]	5.10[a]	45.78[b]	11.52[b]	25.10[b]	27.72[a]	0.61[a]

	14	0.945[a]	4.43[b]	49.82[a]	13.34[a]	30.99[a]	33.76[a]	0.68[a]
Stderr		0.003	0.01	0.46	0.39	0.86	3.90	0.07
Treat		0.0003	0.001	0.0001	0.0001	0.0001	0.325	0.198
Time		0.0001	0.001	0.0001	0.0001	0.0001	0.001	0.001
Treat*Time		0.0008	0.001	0.0001	0.0001	0.0001	0.140	0.897

[ab] Means with different letters indicate significantly differences between treatments ($P<0.05$).

Color of chorizo blends of rabbit meat and textured soybean

The color values L*, a*, b*, C and h showed statistically significant differences ($p <0.05$), even though there was great variability in the mean values of L *. As can be seen in all treatments, the values decrease to day 7 and then increase to day 14. This may be due to the effect of vacuum packing coupled with microbial growth which might be affecting the color of the product. Regarding the a* value, it can be stated that in all treatments, the value decreased at day 7, but returned to similar values at day 14. Regarding the b* parameter, it can be seen that there were significant differences ($p<0.05$) showing an immediate increase on day 7 continuing up until day 14 with a higher value. Regarding the values of C and h, significant differences ($p<0.05$) could be observed in treatment 3 for the first parameter, while in the second it was in treatment 2 and 4.

Texture profile analysis of chorizo blends of rabbit meat and textured soybean

Table 3 shows the texture of raw sausage made with different proportions of textured soybean. It was found that there are significant statistical differences ($p<0.05$) in the various parameters of the texture profile analysis. The hardness of the chorizo was affected by the amount of soybean added. There was no difference in the first soybean levels, but hardness decreases (16.67 N) when 20% of textured soybean is added. Treatment 5 presented the highest adhesiveness of all the chorizo

produced. In the case of cohesiveness, this variable decrease as the levels of textured soybean protein are increased, while springiness increases as the proportion of meat decreases.

Table 3. Texture profile analysis of rabbit meat raw sausage added with textured soybean.

	Treatments				
	T1	**T2**	**T3**	**T4**	**T5**
Hardness (N)	22.55 ± 5.88^a	18.63 ± 2.94^{ab}	16.67 ± 1.96^b	18.63 ± 5.88^{ab}	26.47 ± 0.98^a
Adhesiveness (-N)	0.03 ± 0.02^b	0.05 ± 0.03^b	0.03 ± 0.02^b	0.07 ± 0.04^b	0.14 ± 0.07^a
Resilience	0.13 ± 0.01^a	0.11 ± 0.01^b	0.12 ± 0.01^b	0.09 ± 0.01^b	0.10 ± 0.01^b
Cohesiveness	0.47 ± 0.01^a	0.43 ± 0.01^a	0.44 ± 0.02^a	0.39 ± 0.01^b	0.39 ± 0.03^b
Springiness	0.74 ± 0.01^b	0.77 ± 0.02^a	0.77 ± 0.01^a	0.79 ± 0.02^a	0.77 ± 0.01^a

[ab] Means with different letters indicate significantly differences between treatments ($p<0.05$).

Sensory analysis

The sensorial attributes evaluated in the rabbit chorizo can be seen in Table 4. Regarding the color attribute, there are significant differences between T1 compared to the other treatments as it is darker. Additionally, it can be observed that T1 and T3 presents greater hardness values compared to the other treatments, while T4 has a softer texture, which might be because this treatment has a higher percentage of textured soybean protein. Taste values show significant differences ($p<0.05$), with T4 having a higher taste intensity than T1. Finally, the odor and global appreciation attributes do not provide significant differences between treatments ($p>0.05$).

Table 4. Sensorial characteristics of rabbit meat raw sausage added with textured soybean.

Treatments	Sensory attribute				
	Color	**Odor**	**Hardness**	**Taste**	**Global appearance**
T1	163 ± 0.8^a	99.2 ± 1.1^a	145 ± 1.0^a	69.8 ± 1.1^b	109 ± 1.3^a

T2	90 ± 1.0^{b}	96.3 ± 1.1^{a}	89 ± 1.1^{b}	115.7 ± 1.0^{a}	95 ± 1.1^{a}
T3	86 ± 0.8^{b}	101.2 ± 1.1^{a}	151 ± 0.9^{a}	96.8 ± 0.9^{ab}	93 ± 1.0^{a}
T4	71 ± 0.9^{b}	113.2 ± 1.2^{a}	70 ± 0.8^{c}	127.5 ± 1.1^{a}	113 ± 1.1^{a}

[ab] Means with different letters indicate significantly differences between treatments ($p<0.05$).

Discussion

The pH and A_w are important for the stability of meat products, but they are influenced by different factors, such as the composition of meat ingredients. Hidayat *et al*. (2018) mentioned textured vegetable protein is more water soluble and has lower fat content, characteristics that make the protein bind more freely with water so the water holding capacity increases in sausages. However, with a high textured soybean content, syneresis is probably produced leading to increased A_w in T5 treatment. A similar process arises when amylose molecules produce starch retrogradation in vacuum packed processed meat (Hoogenkamp, 2004). Regarding pH, significant differences were found throughout the conservation process (P<0.05), with lower values at 14 d of storage in all treatments. This behavior could be due to the formation of acid, probably because there is an increase in the amount of lactic acid producing bacteria, specifically those belonging to the group of lactic acid bacteria as indicated by Cobos Velasco *et al*. (2014).

The color is an important parameter used to buy meat products. Color of raw sausage products vary according to ingredients used to process them. Textured soybean protein can absorb pigment and decrease color values, mainly L*. Gimeno *et al*. (2000) characterized chorizo from Pamplona and reported L* values of between 46.8 and 54.3, a* values (20.4 and 26.2) and b* values (10.9 and 17.7), the latter is not in concordance with results from this work. These authors attribute the color to the ingredients that are used during processing, mainly when paprika was used.

Another important attribute for measure the quality of a meat product is texture. One of the parameters used in TPA is hardness of a product. This attribute could be modified by using textured soybean protein as indicated in this work´s results. Nishinari *et al*. (2014) indicate that the advantages of soybean protein are its processing ability to form gel, emulsifying property and water

holding capacity, characteristics which are important for a product´s hardness. Egbert and Payne (2009) indicated that the hydration property of plant protein in emulsified and coarse ground meat systems produce a gel. Tirado *et al*. (2015) characterized chorizos in Cartagena, Colombia, and found that the texture attributes vary according to where the product is acquired, indicating that cohesiveness fluctuates between 0.53 and 0.72, while hardness between 4.2 to 8.6 N.

Finally, a sensory analysis is used to measure consumer acceptance. In this work, all treatments (T1 to T4) used for measuring sensorial characteristics of blends of textured soybean protein and rabbit meat were accepted by the assessors. Tavares *et al*. (2007) obtained acceptation by consumers in sensorial analyses of rabbit meat burgers, suggesting that rabbit meat has potential technological use in the production of meat products. Carvalho *et al*. (2017) did not show any improvement in sensory properties when textured soybean protein was used in processing beef burgers.

Conclusion

In conclusion, textured soybean protein can be blended with rabbit meat for processing chorizo. The meat product obtained has sensorial characteristics, texture profile, A_w and color acceptable for this kind of raw sausage, especially in blends with 20 and 30% of textured soybean protein. Moreover, the blend of these two meat ingredients improved nutritional properties and could be offered as a functional meat product.

References

Asgar, MA, Falizah, A, Huda, N, Bhat, R, Karim A.A. (2010). Non meat protein alternatives as meat extenders and meat analogs. Critical Reviews in Food Science and Food Safety. 9:513-529.

Carvalho, GR, Milani, TMG, Trinca, NRR, Nagai, LY, Barreto, ACS. (2017). Textured soy protein, collagen and maltodextrin as extenders to improve the physicochemical and sensory properties of beef burger. Food Science and Technology Campinas. 37:10-16.

Chodová, M, Tumová, E. (2013). The effect of feed restriction on meat quality of broiler rabbits: A review. Scientia Agriculturae Bohemica. 44:55-62.

Cobos Velasco, JE, Soto Simental, S, Alfaro Rodríguez, RH, Aguirre Álvarez, G, Rodríguez Pastrana, BR, González Tenorio, R. (2014). Evaluación de parámetros de calidad de chorizos elaborados con carne de conejo, cordero y cerdo, adicionados con fibra de trigo. Nacameh. 8:50-64.

Dalle Zotte, A, Celia, C, Szendro, Z. (2016). Herbs and spices inclusion as feedstuff or additive in growing rabbit diets and as additive in rabbit meat: A review. Livestock Science. 189:82-90.

Egbert, WR, Payne, CT. (2009). Plant protein. In: Ingredients in Meat Products. R. Tarté (ed.). Springer. NY, USA.

Gimeno, O, Ansorena, D, Astiasaraín, I, Bello, J. (2000). Characterization of chorizo de Pamplona: instrumental measurements of colour and texture. Food Chemistry. 69:195-200.

Gök, V, Akkaya, L, Obuz, E, Bulut, S. (2012). Effect of ground poppy seed as a fat replacer on meat burgers. Meat Science. 89:400-404.

González-Tenorio, R, Caro-Canales, I, Soto-Simental, S, Rodríguez Pastrana, BR, Mateo, J. (2012). Características microbiológicas de cuatro tipos de chorizo comercializados en el Estado de Hidalgo, México. Nacameh 6:25-32.

González-Tenorio, R., Totosaus, A., Caro, I. Mateo, J. (2013). Caracterización de propiedades químicas y fisicoquímicas de chorizos comercializados en la zona centro de México. Información Tecnológica. 24:3-14.

Hidayat, BT, Wea, A, Andriat, N. (2018). Physicochemical, sensory attributes and protein profile by SDS-PAGE of beef sausage substituted with texturized vegetable proteins. Food Research. 2:20-31.

Hoogenkamp, HW. (2004). Soy Protein Essentials. In: Soy Protein and Formulated Meat Products. Ed. Hoogenkamp, H. Cambridge, MA. USA. CABI Publishing.

Jalal, H, Mir, S, Wani, SA, Sofi, AH, Pal, MA, Rather, F. (2013). Development of low fat meat products. International Journal of Food Nutrition and Safety. 4:98-107.

Londero, PMG, Prestes, RC, Roman, SS, Kubota, EH, Hübscher, GH, Silva, CG, Fischer, L, Alves, J. (2015). Development of functional beef meatball using landrace common bean flour as a substitute for meat and textured soy protein. International Food Research. Journal. 22:2041.

Malav, OP, Talukder, S, Gokulakrishnan, P, Chand, S. (2015). Meat analogue: A review. Critical Reviews in Food Science and Nutrition. 55:1241-1245.

Nishinari, K, Fang, Y, Guo, S, Phillips, GO. (2014). Soy protein: A review on composition, aggregation and emulsification. Food Hydrocolloids. 39:301-318.

Omwamba, M, Mahungu, SM, Faraj, AK (2014). Effect of texturized soy protein on quality characteristics of beef samosas. International Journal of Food Studies. 3:74-8.

Orcutt, MW, Mcmindes, MK, Chu, H, Mueller, IN, Bater, B, Orcutt, AL. (2006). Textured soy protein utilization in meat and meat analog products. In: Soy Applications in Food. Ed. M.N. Riaz. Boca Ratón, Fl. USA: CRC Press.

Para, PA, Ganguly, S, Wakchaure, R, Sharma, R, Mahajan, T, Praveen, PK. (2015). Rabbit Meat has the Potential of Being a Possible Alternative to Other Meats as a Protein Source: A Brief Review. Inter. Journal of Pharmacological and Biomedical Research. 2:17-19.

Porcella, MI, G, Sánchez, G, Vaudagna, SR, Zanelli, ML, Descalzo, AM, Meichtri, LH, Gallinger, MM, Lasta, JA. (2001). Soy protein isolate added to vacuum-packaged chorizos: effect on drip loss, quality characteristics and stability during refrigerated storage. Meat Science. 57 :437-443.

Singh, P, Kumar, R, Sabapathy, SN, Bawa, AS. (2008). Functional and edible uses of soy protein products. Comprehensive Reviews in Food Science and Food Safety. 7:14-28.

Tavarez, RS, Cruz, AG, Oliveira, TS, Braga, AR, Reis, FA, Hora, IMC, Teixeira, RCI, Ferrerira, EF. (2007). Processing and sensorial acceptance of rabitt hamburguer. Ciência e Tecnologia Alimentos, Campinas, 27(3): 633-636.

Tirado, D, Acevedo, D, Montero, P. (2015). Calidad microbiológica, fisicoquímica, determinación de nitritos y textura de chorizos comercializados en Cartagena (Colombia). Revista U.D.C.A Actividades de. Divulgación Científica. 18:189.

UNE-87024-1. (1995). Análisis Sensorial. Guía General para la selección, entrenamiento y control de jueces. Parte1: Catadores. AENOR.

UNE-ISO-8587. (2010). Análisis sensorial. Metodología. Ordenamiento. AENOR.

Yadav, SK, Tanwar, VK, Sharma, JK, Yadav, S. (2013). Effect of added soy protein on physicochemical properties of chevon patties. Journal of Meat Science and Technology. 1:35-39.