

## PREFERENCE AND ACCEPTANCE OF FRESH RABBIT, PORK AND CHICKEN MEAT SAUSAGES AMONG YOUNG CONSUMERS

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**Abstract:** The rabbit sector has proposed sausages as a suitable presentation format to increase rabbit meat consumption among young people in a context in which it is declining in several traditionally-consuming countries. In order to confirm its suitability in this context, this work compares the acceptability and preference of commercial fresh rabbit sausages with those of chicken and pork meat, using an untrained panel of 70 young Spanish consumers (22.1 yr old on average; 57.1% male and 42.9% female). In the first part of the trial, cooked sausages were evaluated for: a) acceptability of organoleptic characteristics (odour, colour, appearance, texture, flavour, elasticity and juiciness) and the overall rating using a 9-point hedonic scale, and b) order of preference of sausages (first to third). Overall acceptance and sensory attributes were rated in the medium-high range (6.1-7.9 points) and differed among the cooked sausages, except for odour and appearance. Rabbit sausage was rated at the same level as chicken and pork sausages in terms of odour, appearance, texture, flavour and overall assessment, outperformed pork sausage in colour, elasticity and juiciness acceptance, and was only rated lower than chicken sausage in terms of juiciness. Cooked chicken sausage was preferred in first place, followed by rabbit sausage, while pork sausage came last. In the second part of the trial, raw sausages were evaluated visually for: a) acceptability of colour and visual appearance, and b) order of preference of the sausages. No difference was found between the raw sausages in terms of colour, while the appearance of the raw pork sausage was rated better than that of the rabbit and chicken sausages, with no difference between the latter two. The visual appearance of the raw pork sausage was ranked first, followed by the chicken sausage, while the raw rabbit sausage came last. Only 40% of the young panellists could identify the meat ingredient of the rabbit sausage in both cooked and raw sausages. No interaction was found between the type of sausage and the gender of the panellists in evaluation of either the cooked or raw sausages. Young women rated the texture, flavour, elasticity, juiciness and overall assessment of the cooked sausages lower than men, regardless of meat type, whereas no gender difference was found for the visual assessment of the raw sausages. In conclusion, cooked rabbit sausage was accepted as well as chicken sausage overall and better than pork sausage, while raw rabbit sausage was accepted as well as chicken sausage overall and worse than pork sausage in the visual assessment, showing its potential to promote rabbit meat consumption among young people.

**Key Words:** rabbit meat, fresh sausages, consumer preferences, processed products, sensory evaluation, consumer panel.

### INTRODUCTION

The consumption of rabbit meat, traditionally found in the Mediterranean diet and in other regions of the world, has decreased significantly in recent years in Spain and other European countries (Petracci *et al.*, 2018; Ministerio de Agricultura, Pesca y Alimentación, 2021). Several factors have contributed to this decrease in consumption,

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<https://doi.org/10.4995/wrs.2024.20236>

**Cite as:** González-Redondo P., Fierro-Raya M. 2024. Preference and acceptance of fresh rabbit, pork and chicken meat sausages among young consumers. *World Rabbit Sci.*, 32: 43-55. <https://doi.org/10.4995/wrs.2024.20236>

including changes in lifestyle and eating habits, resulting in less time spent preparing home-cooked and traditional dishes (Montero, 2015), changes in working habits and in family structure and size (Ministerio de Agricultura, Pesca y Alimentación, 2006), as well as a lower preference for the organoleptic characteristics and the progressive loss of contact with rabbit meat by some consumers, especially young people and children (González-Redondo *et al.*, 2010; Montero, 2015; Escribá-Pérez *et al.*, 2019). Rabbit meat consumption is increasingly concentrated mainly among older, traditional consumers (Escribá-Pérez *et al.*, 2017). Faced with this situation, one of the proposals made by the processing industry in Spain to retain and attract consumers to rabbit meat, at least in the last 30 yr, has been to market alternative presentations to the whole carcass, such as cuts (thighs, loins, halved or quartered carcasses and loin medallions, among others), and processed products such as burgers and sausages (Leonart, 1994; ASESCU, 1996; De Santos, 2019a). These formats and presentations simplify preparation and some of them, such as burgers and sausages, are more attractive to younger consumers because they are familiar with their consumption when they are made with meat from other animals that are more commonly marketed and consumed (Escribá-Pérez *et al.*, 2019). In fact, several companies are marketing rabbit sausages in Spain and other countries (Li *et al.*, 2018; Fernández, 2019).

Studies have been conducted worldwide on the effects of different ingredients, processing techniques, day of purchase and storage treatments and duration on aspects such as shelf life, oxidative status, physicochemical properties and microbiological quality of fresh raw or cooked rabbit sausages (Abdel Aziz *et al.*, 2012; Hleap *et al.*, 2014; Wambui *et al.*, 2016, 2017; Zaki, 2018; Honrado *et al.*, 2022), as well as their sensory evaluation (Hleap *et al.*, 2014; Wambui *et al.*, 2016; Zaki, 2018; Honrado *et al.*, 2022). Research has also been conducted on scalded and frankfurter-type rabbit sausages (Cury *et al.*, 2011; Asamoah *et al.*, 2019; Casillas-Peñuelas *et al.*, 2019; Escobar-Barrera *et al.*, 2020). These studies on rabbit sausages were carried out with consumer panels or trainer assessors, but without comparing them with sausages made with meat from other animals. Only one study (Lengkey and Lobo, 2016) has compared experimental fresh sausages made with rabbit or chicken meat, focusing on the effects of different fats on the physicochemical and microbiological properties as well as sensory quality. In addition, the literature reports on studies conducted with experimental sausages prepared ad hoc for the trials, with the exception of the work by Wambui *et al.* (2016). However, there is a lack of research on the acceptance and preference, by young consumers, of commercial fresh rabbit sausages which can be found in the market, compared to more commonly available sausages made from other meats.

In this context, this research aimed to evaluate young consumers' acceptance and preference of commercial fresh rabbit sausages, both raw and cooked, by comparing them with sausages made from other lean meats such as pork and chicken. The hypothesis is that young consumers will readily accept sausages made from rabbit meat because this form of presentation modifies, neutralises or eliminates some of the characteristics and attributes that deter them from eating this meat, such as the bone content or the taste with which they are unfamiliar.

## MATERIALS AND METHODS

### *Consumer panel*

A panel of 70 untrained young people was conducted in November 2021 by recruiting panellists from doctoral, master's and undergraduate students at the Higher Technical School of Agricultural Engineering at the University of Seville (Spain). Participation was voluntary and with informed consent.

The average age of the panellists was  $22.1 \pm 0.49$  yr old (mean  $\pm$  standard error), varying between 18 and 30 yr with a mode of 18 yr. Of the young panellists, 57.1% (n=40) were men and 42.9% (n=30) were women.

### *Fresh sausages*

Commercial fresh rabbit, pork, and chicken sausages purchased in hypermarkets in Seville were evaluated. The sausages were packed in transparent pet-tray packages in a modified atmosphere. The nutritional facts and ingredients of the sausages are shown in Table 1. The sausages were kept refrigerated at 3°C until they were used in the sensory evaluation panel.

**Table 1:** Nutritional facts (per 100 g of edible portion) and ingredients of the commercial fresh sausages evaluated (information from the manufacturers labelling).

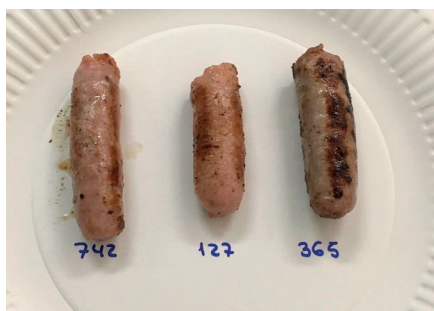
Nutritional value	Sausage		
	Rabbit	Pork	Chicken
Calories (kJ - kcal)	570 - 136	548 - 131	411 - 98
Fat (g)	6.0	7.0	3.4
Saturated fat (g)	2.6	2.6	1.1
Carbohydrates (g)	6.0	1.1	1.6
Sugars (g)	0.5	1.1	1.0
Protein (g)	14.4	16.6	15.2
Salt (g)	1.85	2.10	1.95
Ingredients	Rabbit meat (75%), water, salt, natural spices, starch, vegetal fibres, pea protein, dextrose, preservative (sodium sulphite), antioxidant (ascorbic acid) and colour (carminic acid)	Pork meat (88%), water, salt, cornstarch spices and aromas. Stuffed in natural lamb casing	Chicken meat (86%), water, rice flour, salt, emulsifier (monoglycerides and diglycerides of fatty acids), natural fermentation extracts, antioxidant (sodium ascorbate), spice extracts, potato starch, vegetal fibre, corn glucose syrup, white pepper, sugar, spices and vegetable extracts. Stuffed in natural casing

### **Preparation and sensory evaluation of the cooked sausages**

Sausages were cooked on an electric griddle (Jata® model GR2017, Tudela, Spain) with a little extra virgin olive oil to prevent sticking. The sausages were then served hot to the panellists 1-2 min after cooking.

The colour of the cooked sausages was measured by determining the chromaticity coordinates L\* (lightness), a\* (redness) and b\* (yellowness) (CIE, 1976) using a Minolta CM-700d spectrophotometer (Konica Minolta® Co., Osaka, Japan) with illuminant D65 and a standard observer of 10°. Five determinations were made on each sausage sample at different points, approximately 1-2 min after cooking.

Tastings were conducted according to standard methods for sensory evaluation with untrained consumers (Pagliarini, 2002). The panellists were informed that they had to evaluate the sausages of the three types of meat mentioned above, with blinded identification of the samples. The panellists were provided with disposable cutlery, paper napkins, breadsticks and water. They were given a dish containing a 5 cm sample of each of the three types of sausage, blind-coded with three-digit random numbers and arranged in random order for each panellist (Figure 1). The panellists were instructed to taste and evaluate the sausages from left to right, eat breadsticks and drink water between each two different sausages to cleanse their palates.



**Figure 1:** Presentation of the cooked sausage samples for tasting and evaluation by the panellists. From left to right: cooked rabbit, chicken and pork sausage samples.

Panellists were first asked to rate the degree of acceptability of the organoleptic characteristics (odour, colour, appearance, texture, flavour, elasticity and juiciness) and the overall acceptance for each type of sausage, using a 9-point hedonic scale (1=dislike extremely, 2=dislike very much, 3=dislike moderately, 4=dislike slightly, 5=neither like nor dislike, 6=like slightly, 7=like moderately, 8=like very much, 9=like extremely).

With the same samples as for the previous evaluation, the panellists were then asked to rank the sausages in order of preference using a scale of 1, 2 and 3 for their first, second and third preferences, respectively.

The young panellists were also asked whether they could identify the type of meat used to make each sausage.

### ***Preparation and visual evaluation of raw sausages***

After tasting and rating the cooked sausages, the panellists were asked in the same session to evaluate the visual appearance of the raw sausages in order to assess their attractiveness in a potential purchase decision. The raw sausage samples were taken from the same purchase lots as the cooked sausage samples.

To this end, the young panellists were presented with a dish containing a 5 cm raw sample of each of the rabbit, pork and chicken sausages, blind-coded with a random letter, and the samples were placed in random order for each panellist (Figure 2). The panellists were instructed to rate and evaluate the raw sausages in a clockwise order.

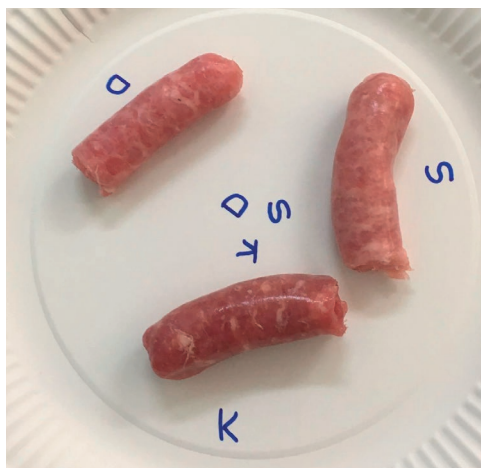
For each raw sausage sample, the panellists were first asked to rate their level of acceptance of the sausage's visual appearance and colour, using a 9-point hedonic scale (described above).

With the same samples as for the previous evaluation, the young panellists were then asked to rank the raw sausages in order of preference using a scale of 1 to 3 for the preference from first to third.

The colour of the raw sausages was measured using the same procedure and equipment as for the cooked sausages. Five determinations were made on each sausage sample at different points, approximately 1-2 min after removal from packaging.

### ***Statistical analyses***

For both cooked and raw sausages, differences in the trichromatic colour coordinates between samples were analysed using a one-way analysis of variance, with Sausage type as a factor.



**Figure 2:** Presentation of the raw sausage samples for visual evaluation by the panellists. Raw rabbit (D), pork (K) and chicken (S) sausage samples.

Two Generalised Linear Model analyses were performed, with Sausage type and Panellist gender as the factors, and the interaction between both factors was assessed. The first was performed on the panellists' evaluation of the sensory attributes (odour, colour, appearance, texture, flavour, elasticity and juiciness) and overall acceptability of the cooked sausages, and the second was performed on the visual evaluation of the colour and appearance of the raw sausages.

Two Friedman tests were performed to analyse the preference order of the sausages, the first for the cooked sausages and the second for the raw sausages.

Tukey post-hoc multiple comparison tests were used to identify differences between sausages (both raw and cooked) for i) physical coordinates of colour, ii) sensory attributes and overall rating, and iii) preference ranking.

For both raw and cooked sausages, differences in the frequency of panellists correctly identifying the type of meat in each sausage were analysed using contingency tables on which Pearson's  $\chi^2$  tests were performed. When significantly different frequencies were found, the standardised residuals (*R*) were calculated to perform multiple comparisons, with *R*=1.96 as the discriminant value for a 95% confidence level.

Statistical significance was accepted at *P*<0.05 for all comparisons. Quantitative results are presented as the mean and standard error. All statistical analyses were performed using the SPSS 15.0 statistical package (SPSS Inc., 2006).

## RESULTS

### Sensory evaluation and preference for cooked sausages

Table 2 shows the effects of the factors of Sausage type and Panellist gender, as well as their interaction, on the comparison of the acceptance of the sensory attributes and the overall acceptance of the cooked sausages of rabbit, pork, and chicken meat by young panellists.

All the sensory attributes evaluated and the overall acceptance of the cooked sausages made with the three types of meat received medium-high average scores from the panellists, varying between 6.1 and 7.9 out of 9 points (Table 2). There was no interaction between the type of sausage type and the gender of the panellists (*P*>0.05).

Sausage type influenced (*P*<0.05) the panellists' evaluation of all sensory attributes and the overall evaluation of the cooked sausages, except for odour and appearance (*P*>0.05). Colour and elasticity were rated lower for pork sausage than for rabbit and chicken sausages, which did not differ from each other (*P*<0.05). Juiciness was rated better in the cooked chicken sausage and worst in the pork, with the rabbit sausage being intermediate in acceptance between the

**Table 2:** Comparison of acceptance (mean±standard error; <sup>1</sup>) of sensory attributes of cooked rabbit, pork and chicken sausages by young panellists (n=70; mean±standard error).

Sensory attribute	Sausage			Panellist gender		P-value		
	Rabbit	Pork	Chicken	Men (57.1%)	Women (42.9%)	Sausage	Gender	Interaction
Odour	6.7±0.18	6.9±0.17	7.2±0.14	7.0±0.12	6.8±0.16	0.150	0.446	0.380
Colour	7.0±0.13 <sup>b</sup>	6.3±0.18 <sup>a</sup>	6.9±0.17 <sup>b</sup>	6.9±0.13	6.5±0.15	<0.001	0.066	0.098
Appearance	7.0±0.16	6.7±0.18	7.1±0.16	7.0±0.12	6.8±0.16	0.180	0.349	0.375
Texture	6.8±0.17 <sup>ab</sup>	6.6±0.18 <sup>a</sup>	7.3±0.15 <sup>b</sup>	7.1±0.12	6.6±0.16	0.005	0.017	0.349
Flavour	7.3±0.19 <sup>ab</sup>	7.0±0.20 <sup>a</sup>	7.7±0.13 <sup>b</sup>	7.6±0.11	7.0±0.19	0.005	0.001	0.147
Elasticity	6.8±0.18 <sup>b</sup>	6.1±0.20 <sup>a</sup>	7.2±0.17 <sup>b</sup>	7.0±0.13	6.4±0.18	<0.001	0.004	0.799
Juiciness	7.2±0.17 <sup>b</sup>	6.3±0.21 <sup>a</sup>	7.9±0.13 <sup>c</sup>	7.4±0.14	6.8±0.17	<0.001	0.012	0.349
Overall assessment	7.2±0.15 <sup>ab</sup>	6.8±0.17 <sup>a</sup>	7.7±0.14 <sup>b</sup>	7.4±0.10	6.9±0.16	<0.001	0.003	0.207

<sup>1</sup>Nine-point hedonic scale: 1=dislike extremely, 2=dislike very much, 3=dislike moderately, 4=dislike slightly, 5=neither like nor dislike, 6=like slightly, 7=like moderately, 8=like very much, 9=like extremely.

<sup>a-c</sup>Means of the same attribute accompanied by different letters are different between cooked sausages (*P*<0.05).

**Table 3:** Friedman test for ranking (1) of overall preference of cooked rabbit, pork and chicken sausages by young panellists (mean range; n=70).

	Sausage			P-value
	Rabbit	Pork	Chicken	
All panellists	2.04 <sup>ab</sup> (2 <sup>nd</sup> )	2.21 <sup>b</sup> (3 <sup>rd</sup> )	1.74 <sup>a</sup> (1 <sup>st</sup> )	0.019
Men (57.1%)	1.88	2.25	1.88	0.153
Women (42.9%)	2.27 <sup>b</sup>	2.17 <sup>b</sup>	1.57 <sup>a</sup>	0.014

<sup>1</sup>Ranking scale of 1, 2, and 3 for preference in first, second and third position, respectively. The ranking of the cooked sausages is indicated in parentheses.

<sup>a,b</sup>Values accompanied by different letters are different between cooked sausages ( $P<0.05$ ).

other two ( $P<0.05$ ). Texture, flavour and overall acceptability were rated better for the cooked chicken sausage than for the pork sausage, with the rabbit sausage being intermediate in acceptance ( $P<0.05$ ), with no difference between the chicken sausage and the pork sausage.

The panellists' gender influenced ( $P<0.05$ ) the sensory evaluation of texture, flavour, elasticity, juiciness and the overall assessment of the cooked sausages by the panellists, with women showing a lower acceptance of the sensory attributes of the sausages than men did (Table 2), regardless of the Sausage type.

Table 3 shows the overall preference ranking, based on organoleptic characteristics, expressed by the panellists for the cooked rabbit, pork and chicken sausages, by Panellist gender and jointly.

The ranking test showed that young panellists, considering both genders together, preferred ( $P<0.05$ ) the cooked chicken sausage in the first place, followed by the rabbit sausage in second place (with no score difference between them), while pork sausage came last (with no score difference from rabbit sausage). When considering the gender of the panellists, men showed no significant differences in the ranking of cooked rabbit, chicken and pork sausages ( $P>0.05$ ). Women, however, ranked cooked chicken sausage first, pork sausage second and rabbit sausage third ( $P<0.05$ ), although there was no significant difference in scoring between rabbit and pork sausages.

Table 4 shows the trichromatic coordinates of the cooked sausages. The lightness ( $L^*$ ) of the cooked rabbit sausage was similar to that of the pork and chicken sausages ( $P>0.05$ ). The redness ( $a^*$ ) of the cooked rabbit sausage was intermediate between the highest redness of the chicken sausage and the lowest redness of the pork sausage ( $P<0.05$ ), and the yellowness ( $b^*$ ) was the highest in the chicken sausage compared to the other cooked sausages ( $P<0.05$ ).

Table 5 shows the frequency of young panellists correctly identifying the type of meat used in the cooked sausages.

The proportion of panellists correctly identifying the meat in the cooked sausages was variable, with differences between sausage types ( $P<0.05$ ). Two-thirds of the young panellists identified the type of meat in the cooked chicken

**Table 4:** Trichromatic coordinates characterising the colour of cooked rabbit, pork, and chicken sausages (n=5; mean±standard error).

Trichromatic coordinate	Sausage			P-value
	Rabbit	Pork	Chicken	
$L^*$	59.8±0.48	57.2±0.84	58.8±1.20	0.210
$a^*$	7.0±0.21 <sup>b</sup>	5.6±0.17 <sup>a</sup>	8.2±0.41 <sup>c</sup>	0.004
$b^*$	15.3±0.23 <sup>a</sup>	15.6±0.34 <sup>a</sup>	21.6±0.70 <sup>b</sup>	0.005

<sup>a-c</sup>Means of the same trichromatic coordinate accompanied by different letters are different between cooked sausages ( $P<0.05$ ).

**Table 5:** Contingency table of young panellists that correctly identified the animal species of meat ingredient of cooked rabbit, pork and chicken sausages (n=70).

	Sausage			P-value
	Rabbit	Pork	Chicken	
Correct identification, n (%)	28 (40.0) <sup>a</sup>	33 (47.1) <sup>b</sup>	45 (64.3) <sup>c</sup>	0.013

<sup>a-c</sup>Values accompanied by different letters are different between cooked sausages ( $P<0.05$ ).

**Table 6:** Comparison of visual evaluation (mean±standard error; <sup>1</sup>) of colour and appearance of raw rabbit, pork, and chicken sausages by young panellists (n=70; mean±standard error).

Sensory attribute	Sausage			Panellist gender		$P_{\text{Sausage}}$	$P_{\text{Panellist gender}}$	$P_{\text{Sausage}} \times P_{\text{Panellist gender}}$
	Rabbit	Pork	Chicken	Men (57.1%)	Women (42.9%)			
Colour	6.6±0.18	7.1±0.17	6.9±0.17	6.9±0.13	6.9±0.16	0.198	0.850	0.529
Appearance	6.4±0.17 <sup>a</sup>	7.3±0.16 <sup>b</sup>	6.7±0.18 <sup>a</sup>	6.9±0.13	6.9±0.16	0.001	0.726	0.628

<sup>1</sup>Nine-point hedonic scale: 1=dislike extremely, 2=dislike very much, 3=dislike moderately, 4=dislike slightly, 5=neither like nor dislike, 6=like slightly, 7=like moderately, 8=like very much, 9=like extremely.

<sup>a,b</sup>Means of the same attribute accompanied by different letters are different between raw sausages ( $P<0.05$ ).

sausage. A significantly lower proportion of panellists (almost 50%) identified the type of meat in the pork sausage. Only 40% of the young panellists were able to identify the type of meat in the rabbit sausage.

**Visual evaluation and preference for raw sausages**

Table 6 shows the effects of the factors Sausage type and Panellist gender and their interaction on the panellists' visual evaluation of the colour and appearance of raw rabbit, pork and chicken sausages. Panellist gender did not influence this visual assessment ( $P>0.05$ ), and there was no interaction between Sausage type and Panellist gender ( $P>0.05$ ).

In general, the visual assessment of the colour and appearance of the raw sausages from the three types of meat resulted in medium-high average ratings by the young consumers, ranging from 6.4 to 7.3 out of 9 points (Table 6). The type of sausage did not influence ( $P>0.05$ ) the visual evaluation of the colour of the raw sausages by the panellists. However, the sausage type did have an influence ( $P<0.05$ ) on the visual assessment of the appearance of the raw sausages. Thus, the young panellists rated the appearance of the raw pork sausage better than that of the chicken and rabbit sausages, although there was no difference between the latter two.

Table 7 shows the ranking of overall preference based on the visual assessment, expressed by panellists for raw rabbit, pork and chicken sausages, broken down by Panellist gender and jointly.

The ranking test (Table 7) shows that the young panellists, considering both genders together, preferred the visual appearance of the raw pork sausage in the first position, followed by the raw chicken sausage in the second position (with no scoring difference from the pork sausage), while the raw rabbit sausage was ranked last (with no scoring difference from the chicken sausage) ( $P<0.05$ ). In general, this ranking pattern was maintained when analysing the ranking of sausages by men ( $P<0.05$ ). However, there were no differences in the scoring of women's preference for raw sausages ( $P>0.05$ ).

The trichromatic coordinates of the raw sausages (Table 8) were characterised by the fact that the lightness ( $L^*$ ) of the raw rabbit sausage was intermediate between that of the chicken sausage, which was the lightest, and that of the pork sausage, which was the darkest ( $P<0.05$ ). The redness ( $a^*$ ) of the raw pork sausage was higher than that of the other two raw sausages ( $P<0.05$ ), which showed no differences between them. In addition, no difference was found in the yellowness ( $b^*$ ) of the raw sausages ( $P>0.05$ ).

**Table 7:** Friedman test for ranking (\*) of visual appearance of raw rabbit, pork, and chicken sausages by young panellists (mean range; n=70).

	Sausage			$P$ -value
	Rabbit	Pork	Chicken	
All panellists	2.20 <sup>b</sup> (3 <sup>rd</sup> )	1.77 <sup>a</sup> (1 <sup>st</sup> )	2.03 <sup>ab</sup> (2 <sup>nd</sup> )	0.038
Men (57.1%)	2.25 <sup>b</sup>	1.70 <sup>a</sup>	2.05 <sup>ab</sup>	0.045
Women (42.9%)	2.13	1.87	2.00	0.587

\*Ranking scale of 1, 2, and 3 for preference in first, second, and third position, respectively. The ranking of the raw sausages is indicated in parentheses.

<sup>a,b</sup>Values accompanied by different letters are different between raw sausages ( $P<0.05$ ).



**Table 8:** Trichromatic coordinates characterising the colour of raw rabbit, pork, and chicken sausages (n=5; mean±standard error).

Trichromatic coordinate	Sausage			P-value
	Rabbit	Pork	Chicken	
L*	54.1±1.21 <sup>b</sup>	47.9±0.75 <sup>a</sup>	59.2±1.13 <sup>c</sup>	<0.001
a*	9.6±0.25 <sup>a</sup>	11.7±0.38 <sup>b</sup>	10.6±0.31 <sup>ab</sup>	0.002
b*	9.9±0.74	11.5±0.45	10.7±0.35	0.155

<sup>a-c</sup>Means of the same trichromatic coordinate accompanied by different letters are different between raw sausages ( $P<0.05$ ).

Table 9 shows the frequency of young panellists who, under visual assessment, were able to correctly identify the type of meat used to make the raw sausages.

The proportion of panellists who, by visual assessment, correctly identified the type of meat used to make the raw sausages was variable, with differences between sausage types ( $P<0.05$ ). Two-thirds of the panellists identified the type of meat in the raw chicken sausage. A significantly lower proportion of panellists (almost 50%) identified the animal species of the meat of the pork sausage. Only 40% of the panellists could identify the type of meat in the raw rabbit sausage by visual inspection.

## DISCUSSION

Although rabbit sausages have historically been produced and consumed in some countries (Maylander, 1918; Martini *et al.*, 2017), in other countries where rabbit meat is traditionally consumed, this presentation is not common on the market or is only purchased in small quantities (Petrescu and Petrescu-Mag, 2018; Szendrő *et al.*, 2020). However, the marketing of rabbit meat in processed forms as an alternative to the whole carcass, such as in the form of sausages, has been advocated for 30 yr (ASESCU, 1996; De Santos, 2019b) in order to increase the consumption of this meat among non-traditional consumer segments, such as young consumers, children and small families (Escribá-Perez *et al.*, 2019; Fernández, 2019). In fact, several companies that produce meat items have included rabbit sausages in their product portfolios. However, their presence at points of sale is often irregular and sometimes scarce, as distribution chains do not maintain them on supermarket and hypermarket shelves due to their low turnover (Fernández, 2019). In addition, their price is higher than that of sausages made from other types of meat, partly due to the complexity of the deboning process of rabbit carcasses and cuts, which is not automated as it is for other types of meat (Petracci and Cavani, 2013). The above factors contribute to hindering the spread of their consumption, which could be increased with adequate promotion to publicise them through advertising campaigns specifically targeted at young audiences (De Santos, 2019b; Fernández, 2019). As proposed for rabbit burgers in the segmentation of Spanish consumers according to cooking styles at home (Montero *et al.*, 2015), rabbit sausages could adapt well to the group of easy cooking styles, which includes the “unconcerned”, “easy cooking” and “ready to eat” segments, which account for a third of consumers, including many young people.

The acceptability test based on the evaluation of sensory attributes, in which the young panellists in this study took part, showed that the cooked fresh rabbit sausage was rated favourably (the acceptability of the sensory attributes ranged from 6.7 to 7.3 out of 9 points) and overall at the same level as chicken sausage and better than pork sausage. Regarding the colour of the sausages, the panellists preferred the colour of the rabbit sausage to that of the pork sausage. Figure 1 shows how the cooked rabbit sausage resembles the chicken sausage and

**Table 9:** Contingency table of young panellists that correctly identified the animal species of meat ingredient of raw rabbit, pork, and chicken sausages (n=70).

	Sausage			P-value
	Rabbit	Pork	Chicken	
Correct identification, n (%)	28 (40.0) <sup>a</sup>	34 (48.6) <sup>b</sup>	44 (62.9) <sup>c</sup>	0.024

<sup>a-c</sup>Values accompanied by different letters are different between raw sausages ( $P<0.05$ ).



the how pork sausage has a slightly different colour. In fact, the rabbit sausage was less reddish in colour than pork and chicken sausages and less yellowish than chicken sausage (Table 4). Thus, the difference in acceptance of the colour of the sausages by the panellist was due to the different colours of their ingredient meats. Indeed, colour is considered the most important attribute of meat quality perceived by consumers (Tomasevic *et al.*, 2021). Although they are all lean meats, there are differences in the colour of rabbit, pork and chicken meat (Tapp *et al.*, 2011). Rabbit meat is generally considered one with higher values of lightness and has a relatively low saturation colour, and it resembles poultry meats although its colour is brighter and deeper (Maj *et al.*, 2012).

The fact that the panellists did not report differences in the acceptability of the texture of cooked rabbit sausages compared to chicken and pork sausages may be because the meat and other ingredients are minced and mixed to give the sausages their typical shape and consistency (Wambui *et al.*, 2017; Honrado *et al.*, 2022). This fact can be considered favourable for the acceptance of rabbit meat by young consumers in this presentation format, as it is known that textural differences between different meats influence consumer acceptance of processed products (Lee *et al.*, 2018). In fact, sensory evaluations in the literature have shown that the texture of rabbit meat frankfurters was similar to that of beef and superior to that of chicken (Whiting and Jenkins, 1981). The texture of rabbit meat may therefore benefit from this presentation format. The sausage presentation also makes it difficult for young consumers to identify what the sausage is made of. Indeed, between 40.0 and 64.3% of the panellists were able to correctly identify the type of meat used to make each cooked sausage, with the lowest value corresponding to rabbit sausage. Furthermore, the panellists in this trial did not report any differences in the acceptability of the flavour of cooked rabbit sausages compared to chicken and pork. This fact, which is partly due to the mincing of the meat and its mixing with spices and other ingredients during preparation (Wambui *et al.*, 2017; Honrado *et al.*, 2022), may also favour the consumption of rabbit meat in this presentation among consumers who do not like the taste and other organoleptic characteristics of rabbit meat in conventional presentations or cooked as traditional dishes, a circumstance that has already been reported, especially among young people (González-Redondo *et al.*, 2010) and children (Escribá-Pérez *et al.*, 2019).

The Friedman ranking test confirmed the panellists' preference for the cooked rabbit sausage in second place behind the chicken sausage and ahead of pork sausage, and also that the preference scores for the rabbit sausage did not differ from those for chicken and pork sausages. This confirms the young panellists' positive acceptance of rabbit meat in this presentation format, partly for the reasons discussed above.

The assessment of the young panellists' acceptance and preference for the visual appearance of raw sausages, as seen through the transparent packaging at the point of purchase, was based on the premise that the visual appearance of a raw sausage may influence the customer's purchase decision and subsequent consumption of the product. Indeed, it has been reported that consumer purchasing decisions are influenced by the appearance and colour quality of rabbit meat on meat shelves (Sanah *et al.*, 2020). The higher acceptance of the visual appearance of the raw pork sausage than that of the rabbit and chicken sausages shown by the young panellists in the present trial may be partly due to the differences in colour between the raw sausages, which are shown in Figure 2, where the colour and appearance appear more similar for the raw rabbit and chicken sausages and markedly different for the pork sausage. In fact, the raw rabbit sausage was lighter and less red in colour than the pork sausage (Table 8). As already discussed for the cooked sausages, the young panellists' different perceptions of the appearance of raw sausages was probably also due to differences in the colour of the meat used as the main ingredient.

The young panellists' preference for the visual appearance of the raw rabbit sausage in third place after the pork and chicken sausages, with similar scores for the raw rabbit and chicken sausages, and with women ranking the three sausages equally, again confirms the favourable acceptance of rabbit meat, at least compared to chicken meat, in this form of presentation among the panellists. Moreover, the sausage presentation also makes it more difficult for the young panellists to identify the type of meat in each raw sausage, especially the rabbit sausage, in line with the known lower familiarity of consumers with rabbit meat compared to pork or poultry meats (Borgogno *et al.*, 2015). This may favour the decision to buy rabbit sausage when young consumers see it on store shelves, as its raw appearance is well accepted and sometimes not easily identifiable compared to other sausage meats that are more common on the market.

The panellists' gender was found to have relatively little influence on the acceptance and preference of sausages. On the one hand, only four sensory attributes of cooked sausages were rated worse by women, regardless of the type of sausage. Women also ranked the order of preference of cooked rabbit sausages worse than chicken sausages, but not than pork sausages. On the other hand, the gender of the panellists did not affect the acceptability of the colour and appearance of raw sausages in the visual assessment. At the same time, women showed no differences in the types of raw sausage when it came to the order of preference in the visual assessment. These results are interesting and generally favourable for the acceptance of rabbit sausages, as it is known that women (Santos and Booth, 1996; Kubberød *et al.*, 2002a; Kubberød *et al.*, 2002b; Kiefer *et al.*, 2005), especially the youngest ones (Santos and Booth, 1996; Kubberød *et al.*, 2002a; 2002b), are less likely to eat meat than men, which has also been reported specifically for rabbit meat in several countries (Hui and McLean-Meynsse, 1996; McLean-Meynsse, 2000; González-Redondo *et al.*, 2010). This phenomenon, which is more pronounced for red meat, is because women are more likely than men to associate meat with unpleasant concepts such as blood or a dead animal (Santos and Booth, 1996). Presenting rabbit meat in the form of a sausage helps to minimise these associations of ideas and therefore also makes it easier for women to make the purchase and consumption decisions for rabbit meat, at least to the same extent as for sausages made from other types of meat.

The sausage presentation, in which rabbit meat is deboned, minced, mixed with other ingredients, homogenised and stuffed into a casing to give it its typical shape, consistency and appearance also has some advantages over other commercial presentations of rabbit meat, which may contribute to its good acceptance, as confirmed by this study. Among the most relevant of these advantages, it is worth highlighting the absence of bones or the standardisation of the taste, which eliminates or modifies some characteristics of other presentations of this meat for which a proportion of children under 18 yr and young adults claim not to consume it (bone content, taste, etc.; González-Redondo *et al.*, 2010; Escribá-Pérez *et al.*, 2019). Indeed, for the production of rabbit sausages, rabbit meat has to be deboned (Petracci and Cavani, 2013; Wambui *et al.*, 2017; Honrado *et al.*, 2022). On the other hand, the characteristic flavour of rabbit meat is modified by mixing it with other ingredients (Wambui *et al.*, 2017; Honrado *et al.*, 2022), among which spices, starch, salt and vegetable fibres and extracts stand out. The good performance of rabbit meat in the production of fresh sausages has been demonstrated in a study on the use of two different extenders in rabbit sausages, which reported their full acceptance by a panel of untrained consumers (Hleap *et al.*, 2014), and in a study on the inclusion of fenugreek (*Trigonella foenum-graecum* L.) seed powder in rabbit sausages, which showed higher acceptability of sensory attributes of sausages with no addition or with up to 5% of fenugreek seed powder (Zaki, 2018).

The results of the present study, derived from the sensory evaluation of cooked sausages and the visual evaluation of raw sausages, show that rabbit meat in this form of presentation is as attractive to young consumers as fresh sausages made from the other two types of meat tested, which are more widely available and more familiar to them. In fact, previous research comparing experimental fresh chicken and rabbit sausages reported no difference between them in the evaluation of flavour, juiciness and overall acceptability by a panel of students (Lengkey and Lobo, 2016), and another study conducted to develop scalded rabbit sausages showed that rabbit meat was rated favourably when compared to a chicken sausage used as a control, except for odour (Escobar-Barrera *et al.*, 2020). Similarly, an experiment replacing pork with rabbit meat in fermented sausages (Ignacio *et al.*, 2020) showed that replacing up to 40% of pork with rabbit meat did not alter any of the sensory attributes when evaluated by a panel of untrained students. The good evaluation and acceptance of the rabbit sausages in this study is also in line with the results of a similar study in which commercial rabbit, chicken, pork and turkey burgers were evaluated by a panel of young consumers (Lacalle-Ruiz and González-Redondo, 2021). Only one study, conducted to process rabbit meat into frankfurter-type sausages, reported a poorer evaluation of their sensory attributes by a panel of untrained students compared to beef sausages used as a control (Asamoah *et al.*, 2019).

Furthermore, rabbit meat has an excellent nutritional quality and is healthy because it is lean and rich in protein with a high biological value, with a good lipid profile and a low cholesterol content, as well as a high phosphorus and low sodium content, among other nutritional properties favourable for the human diet (Hernández and Gondret, 2006). In fact, studies have been carried out on the use of rabbit meat for the development and evaluation of low-fat sausages

that meet trends in consumer demand for healthy foods (Lengkey and Lobo, 2016; Honrado *et al.*, 2022). In any case, the fat content of sausages depends on the fat content of the parts of the carcass selected to obtain the meat used in their manufacture, since the parts of the rabbit carcass differ in their fat content (Hernández and Gondret, 2006).

To our knowledge, this is the first study to investigate the acceptance and preference of commercially available fresh sausages made from rabbit meat compared to sausages made from other lean meats by a panel of young consumers. The comparison of commercially available sausages may have the disadvantage that rabbit, pork and chicken sausages differed in several factors, from meat content to other ingredients such as spices, which may influence the choice. Therefore, it would be interesting for further research to compare the acceptance and preference of sausages made from rabbit meat with those made from other types of meat, using the same percentage of meat and other ingredients. However, the meat content of the three commercial sausages evaluated in this study was high and relatively similar (range 75-88%; Table 1), so the meat of origin essentially determined their evaluation. This had the advantage of allowing the panellists to form an opinion and make a choice about products they could buy in shops, a relevant aspect as some of the young panellists were emancipated and, overall, all of them had the ability to buy and make purchase decisions about food products.

## CONCLUSIONS

In terms of acceptance of sensory attributes by young panellists, cooked commercial fresh rabbit sausage was rated overall at the level of chicken sausage and better than pork sausage. Specifically, it was rated at the same level as chicken and pork sausages for odour, appearance, texture, flavour and overall acceptance; it outperformed pork sausage in colour, elasticity and juiciness acceptance, and was rated worse than chicken sausage only in juiciness acceptance. Visual appearance was better accepted in the raw pork sausage than in the rabbit and chicken sausages. Young women rated the texture, flavour, elasticity, juiciness and overall assessment of the cooked sausages lower than men, regardless of sausage type, whereas no gender difference was found for the visual appearance of the raw sausages. This indicates the potential of the sausage presentation format to promote rabbit meat consumption among young people. This presentation, in which the meat is deboned, minced, mixed with other ingredients, homogenised and stuffed into a casing to give it its typical shape and appearance, also has some advantages over other commercial presentations of rabbit meat, which may contribute to its good acceptance, making it easier also for women to make the purchase and consumption decisions for rabbit meat, at least to the same extent as for sausages made with other types of meat. In addition, practical implications for improving the marketing of processed rabbit meat products can be derived from the present study, since the different acceptance by the young consumers of the sensory attributes of the sausages, especially the colour, due to the different characteristics of the meats used in them, suggests that rabbit sausages could be improved with well-chosen ingredients. Appropriate marketing strategies to increase the consumption of rabbit meat among young people by promoting processed products such as sausages can be based on the ease of preparation and the excellent nutritional properties of this meat.

**Acknowledgements:** The authors thank the students who participated in the sensory evaluation of sausages.

**Authors contribution:** González-Redondo P.: conceptualization, methodology, resources, validation, formal analysis, investigation, data curation, writing—original draft, writing—review & editing, visualization and supervision. Fierro-Raya M.: methodology, formal analysis, investigation, data curation and writing—original draft.

**Conflict of interest:** The authors declare that they have no conflicts of interest.

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