Consumers' Perceptions of Intrinsic and Extrinsic Attributes as Indicators of Safety and Quality of Chicken Meat: Actionable Information for Public Health Authorities and the Chicken Industry

Wendy Katiyo [a], Ranil Coorey [b], Elna M. Buys [a] and Henrietta L. de Kock [a*]

[a]Department of Consumer and Food Sciences, University of Pretoria, Private Bag X20, Hatfield 0028, South Africa

[b]School of Molecular and Life Sciences, Faculty of Science and Engineering, Curtin University, GPO Box U1987, Perth, Western Australia 6845, Australia

*Corresponding author e-mail address: riette.dekock@up.ac.za (Henrietta L. de Kock)

Abstract

Understanding consumers' perceptions towards chicken meat safety and quality could provide valuable information to public health educators since it is the most consumed meat. This study explores perceptions of a group of South African consumers on the safety and quality of chicken meat based on intrinsic and extrinsic attributes and identifies related safety risks. Data were collected through a web-based survey (863 participants). A substantial proportion of consumers considered supermarkets as the most trusted outlets to sell safe and good quality chicken (compared with butcheries, wholesalers, farmers' markets, street vendors or 'other retailers'). The majority of respondents (53%) most trusted refrigerated chicken to be of good quality compared with 36% trusting frozen chicken or 11% chicken at room temperature. Frozen chicken was considered most safe by 48% of consumers while 43% regarded refrigerated chicken as most safe. At point of purchase and home, smell, use-by date, sell-by

date and color were perceived as important attributes when judging chicken safety and quality. Consumers considered the absence of brine use and growth-promoting hormones in chicken feed as relatively important. The majority of consumers can be classified as highly involved during purchasing. It is essential that consumers apply safe chicken handling practices from point of purchase to consumption, irrespective of the type of retailer, perceived sensory characteristics and date labels to reduce or eliminate microbial risks. Addressing consumers knowledge and expectations regarding factors such as growth-promoting hormones and free-range may improve safety and quality perceptions.

Practical Application: This study gives insight into perceptions of a group of South African consumers towards safety and quality of chicken meat. Understanding consumers' perceptions can provide valuable information to public health educators since chicken meat is a common vehicle for *Salmonella* spp. and *Campylobacter* spp., which are human pathogens. Additionally, this information can assist the chicken industry to meet consumer expectations.

Keywords: chicken meat, safety, consumers, risk assessment

Introduction

In line with global trends, chicken meat consumption in South Africa has expanded rapidly, supported by rising incomes, dynamic social class mobility, and urbanization (BFAP/NAMC, 2018). Per capita consumption of chicken in South Africa in 2017 was 39 kg and it is expected to exceed 45 kg by 2027 (SAPA, 2018). In contrast, only 18 kg beef, 5 kg pork and 3 kg mutton and goat were consumed per capita in the same year (SAPA, 2018).

In contrast to the objectively defined perspectives of safety and quality by meat scientists, consumers' views of these concepts are highly subjective. Consumers' perceptions of the safety

and quality of chicken meat are of interest to farmers, processors and retailers because these are linked to expectations and choices (Troy & Kerry, 2010).

Meat quality is defined by consumer preferences. The quality of fresh meat "indicates its usefulness to the consumer and its acceptability for cooking" (Joo, Kim, Hwang, & Ryu, 2013). Consumers form inferences regarding the quality of meat using cues (Sepúlveda, Maza, & Pardos, 2011). The cues stimuli provide information about the product leading to particular behaviors by consumers e.g. making choices. Intrinsic cues relate to physical product characteristics (e.g. color, smell, texture) whereas extrinsic cues relate to the product but are not physically part of it (e.g. brand, quality stamp, date label, origin, packaging, production and processing information, price, place of purchase, media information, anecdotes) (Djekic, Skunca, Nastasijevic, Tomovic, & Tomasevic, 2018; Font-i-Furnols & Guerrero, 2014). Consumers use color and freshness as the leading quality cues when selecting chicken meat (Djekic et al., 2018; Skunca et al., 2016). For many European consumers, the impact of price has reduced significantly and health, animal welfare and environmental factors have become more critical (McCarthy, O'Reilly, Cotter, & de Boer, 2004; Pouta, Heikkilä, Forsman-Hugg, Isoniemi, & Mäkelä, 2010). The relative importance of extrinsic factors seems to vary by country.

Meat that is safe and suitable for human consumption is characterized as having been processed under adequate hygiene control, not containing chemical residues in excess of established limits, not been treated with illegal substances as specified in relevant national legislation, free of physical contaminants and not causing foodborne infection or intoxication when properly handled and prepared (Codex Alimentarius Commission, 2005). Unfortunately, chicken is an important vehicle for human pathogenic bacteria, particularly, *Salmonella* spp. and *Campylobacter* spp. causing a food safety challenge (Magwedere, Rauff, De Klerk, Keddy, & Dziva, 2015). Foodborne disease outbreaks are a common occurrence in South Africa

(Niehaus, Apalata, Coovadia, Smith, & Moodley, 2011). Studies, mostly conducted in developed countries, have concluded that consumers play an essential, active role in the safety of poultry products representing the final step for the prevention of foodborne illnesses (Donelan, Chambers, Chambers IV, Godwin, & Cates, 2016; Koppel et al., 2015; Kosa, Cates, Bradley, Chambers IV, & Godwin, 2015). In our recent study investigating South African consumers' knowledge and handling practices for chicken meat, we established that there is potential for foodborne illnesses due to mishandling of chicken meat and lack of knowledge about factors affecting the safety of chicken meat by many consumers (Katiyo, de Kock, Coorey, & Buys, 2019). The development of safe chicken handling guidelines for consumer education interventions was recommended. Similar to quality perceptions, consumers also use cues to predetermine safety of chicken meat, with freshness being reported as the most important indicator (Becker, Benner, & Glitsch, 2000; Glitsch, 2000).

Therefore, this study (i) explored perceptions of a subset of South African consumers on the safety and quality of chicken meat based on intrinsic and extrinsic attributes, and (ii) identified perceptions that may lead to safety risks.

Materials and Methods

Questionnaire design and online survey

A structured questionnaire was designed by modifying questions from an existing survey by Sismanoglou and Tzimitra-Kalogianni (2011). The questionnaire was pilot-tested (94 participants), revised and administered for a large-scale online survey (863 participants) following the method outlined in our earlier publication (Katiyo et al., 2019). Socio-demographic characteristics of the respondents were described in the earlier publication. The

research protocol was approved by the ethics committee of the Faculty of Natural and Agricultural Sciences, University of Pretoria, South Africa (EC161205-087).

The final questionnaire (see Appendix A) obtained information on (i) consumers' habits for purchasing and consumption of chicken meat (questions 1-3), (ii) consumers' quality and safety perceptions of intrinsic and extrinsic attributes of chicken meat at point of purchase and before preparation at home (questions 4-9), and (iii) consumers' socio-demographic characteristics (questions 10-12). Intrinsic and extrinsic attributes of chicken meat for section (ii) of the questionnaire (questions 4-9) were selected based on existing literature (Glitsch, 2000; Sismanoglou & Tzimitra-Kalogianni, 2011) and label information on primary processed refrigerated and frozen raw chicken from six different South African supermarkets. Question 4 related to the type of retailer that respondents most trusted to sell good quality and safe chicken meat (see Appendix A). Question 5 related to the chicken product, with respect to temperature state, that respondents most trusted to be of good quality and safe when purchasing. For questions 6 and 7, the respondents were asked how important were twelve different attributes of chicken meat to them when judging the quality and safety of raw chicken at point of purchase. The attributes considered were smell, color, amount of visible fat, damaged packaging, price, sell-by date, use-by date, brand name, free-range, no growth hormones in feed, no brine injected into meat and country of origin. Similarly, for questions 8 and 9, the respondents were asked how important were five attributes of chicken meat to them when judging the quality and safety of raw chicken before preparation at home. The attributes were smell, color, how the meat feels to the touch (texture), sell-by date and use-by date. Responses to questions 6 and 8 were rated on a scale from 1 (not important at all) to 7 (extremely important). Question 7 requested ranking of the attributes from 1 being most important to 12 being least important, and question 9 requested ranking of the attributes from 1 being most

important to 5 being least important. The attributes were presented to different respondents in a randomized order to prevent possible rating and ranking bias.

Statistical analysis

The chi-square test was employed to compare proportions of consumers according to purchasing and consumption habits for chicken meat (questions 1-3, see Appendix A). The chi-square test was also used for comparisons between proportions of consumers according to perceptions of the quality and safety of chicken meat from different types of retailers and temperature state of chicken meat (questions 4 and 5). Consumers' mean ratings and rankings on the importance of attributes of chicken meat when assessing its quality and safety were compared using the Friedman's test followed by the Dunn-Bonferroni post hoc test (questions 6 - 9). SPSS software was employed (version 20.0, IBM SPSS Statistics Inc., Armonk, NY, USA). K-means cluster analysis with determinant (W) clustering criterion was also performed to distinguish different consumer groups based on their perceptions of attributes of chicken meat. The optimal number of clusters was determined using the elbow method (Liu et al., 2018). Differences between clusters in terms of socio-demographic characteristics and consumers' perceptions were assessed through the chi-square test and analysis of variance (ANOVA) followed by the Fisher's Least Significant Difference test, respectively using XLSTAT version 2019 (Addinsoft XLSTAT, NY, USA). All the analyses were conducted at 95% confidence level.

Results

Purchasing and consumption habits

More than 75% of the respondents consume chicken meat in their households twice a week or more (Figure 1). Many of the respondents (76%) mostly purchase raw chicken at

supermarkets. Respondents (1%) who selected the 'other retailers' option specified that they buy raw chicken at home-based stores ('spaza shops' and tuck shops) and/or directly at chicken abattoirs. In South Africa, a 'spaza shop' or tuck shop refers to a small, informal grocery shop most often run from a section of a residential home in order to supplement household income (Ligthelm, 2013). The results also showed that raw chicken meat sold frozen or refrigerated is the most popular form (94%).

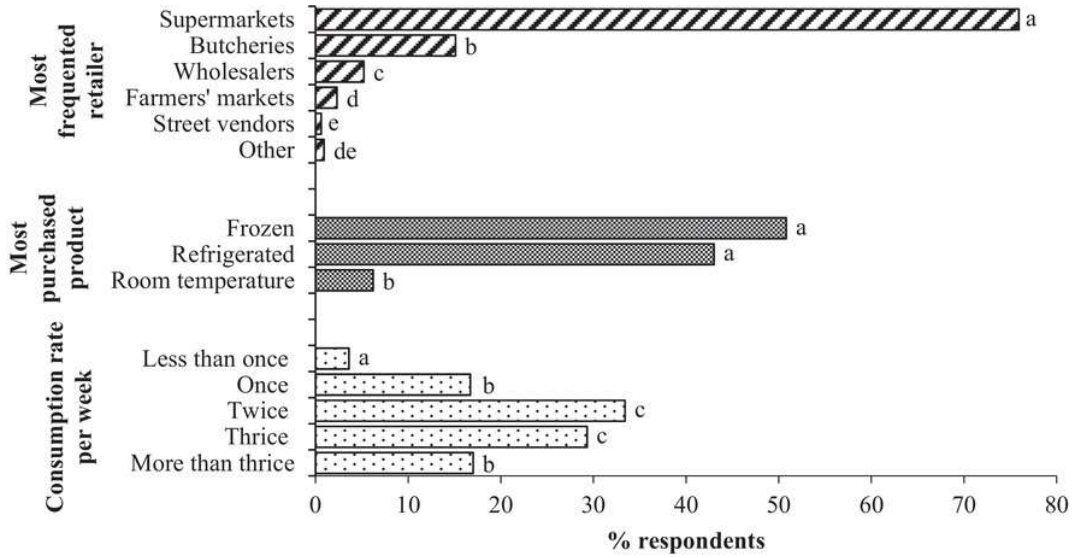

Fig 1. Consumers' habits for purchasing and consumption of chicken meat. Proportions of respondents with different letters between categories for each question are significantly different (χ^2 test, $P < 0.05$, $n = 863$).

Perceptions of intrinsic and extrinsic attributes of chicken meat

Fifty-five % respondents reported that they most trusted supermarkets to sell safe chicken meat while 47% most trusted supermarkets to sell good quality chicken meat (Figure 2). Twenty-six % of the respondents most trusted butcheries for safe chicken meat while 28% most trusted butcheries for good quality chicken meat. Street vendors were most trusted by less than 1% of the respondents for safe and good quality chicken meat. Respondents (53%) mentioned that they most trusted refrigerated chicken to be of good quality (Figure 3). A significantly lower number of the respondents (36%, $p<0.05$) most trusted frozen chicken to be of good quality. Only 11% most trusted chicken meat sold at room temperature to be of good quality.

There was no significant difference between the number of respondents who most trusted frozen chicken to be safe (48%) and those who most trusted refrigerated chicken to be safe (43%). The rest of the respondents (9%) most trusted chicken sold at room temperature to be safe.

Fig. 2. Type of retailers most trusted by respondents to sell safe and good quality chicken meat. Proportions of respondents with different letters for each parameter are significantly different (χ^2 test, $P < 0.05$,$n = 863$).

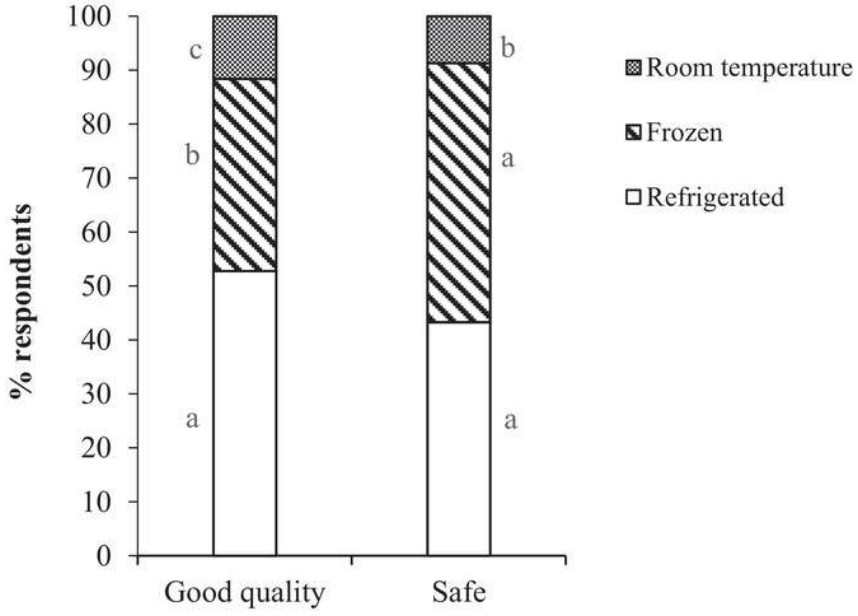

Fig 3. Temperature state of chicken meat most trusted by respondents to be safe and of good quality. Proportions of respondents with different letters for each parameter are significantly different (χ^2 test, $P < 0.05$,$n = 863$).

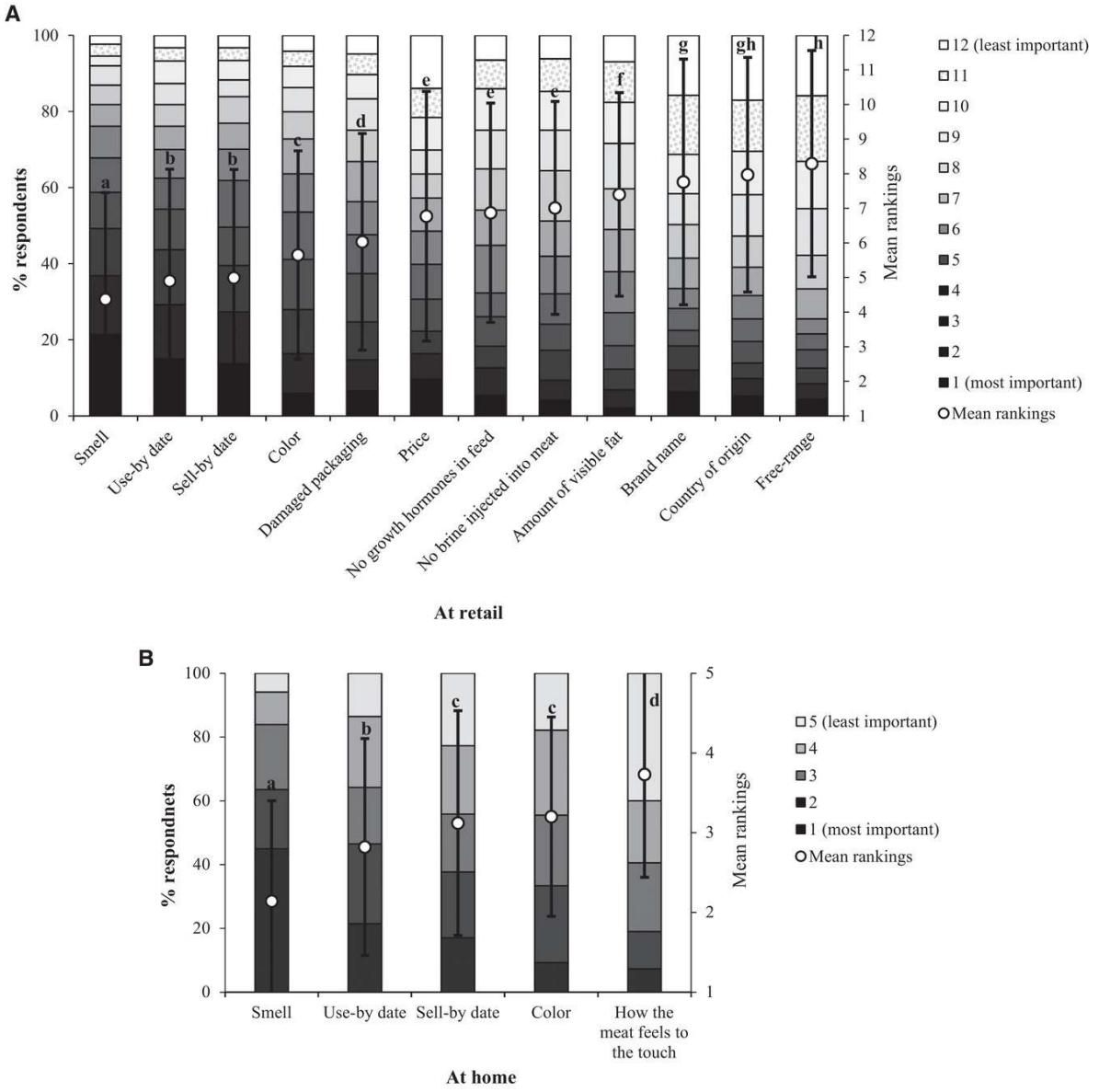

Fig. 4. Ranking of importance of attributes of chicken meat when assessed by consumers for safety at retail (A) and home (B). At retail, attributes of chicken meat were ranked from 1 for the attribute considered most important to 12 for the attribute considered least important. At home, they were ranked from 1 for the attribute considered most important to 5 for the attribute considered least important. An attribute with the lowest mean ranking is the most important. Mean rankings with different letters are significantly different (Friedman's test, $P < 0.05$, n = 863).

The most important attribute when assessing the safety of chicken meat at point of purchase was smell ($p<0.05$) (Figure 4A). More than half of the respondents (67%) ranked this attribute

lower than the central rank position (<6), indicating its importance. Use-by date and sell-by date were the second most important attributes, followed by color. The attributes, price, no growth hormones in feed and no brine injected into meat were considered equally important. The attributes considered to be least important were country of origin and free-range. Before preparation of chicken at the home, smell was also ranked as the most important attribute (Figure 4B). How the meat feels to the touch was considered as least important.

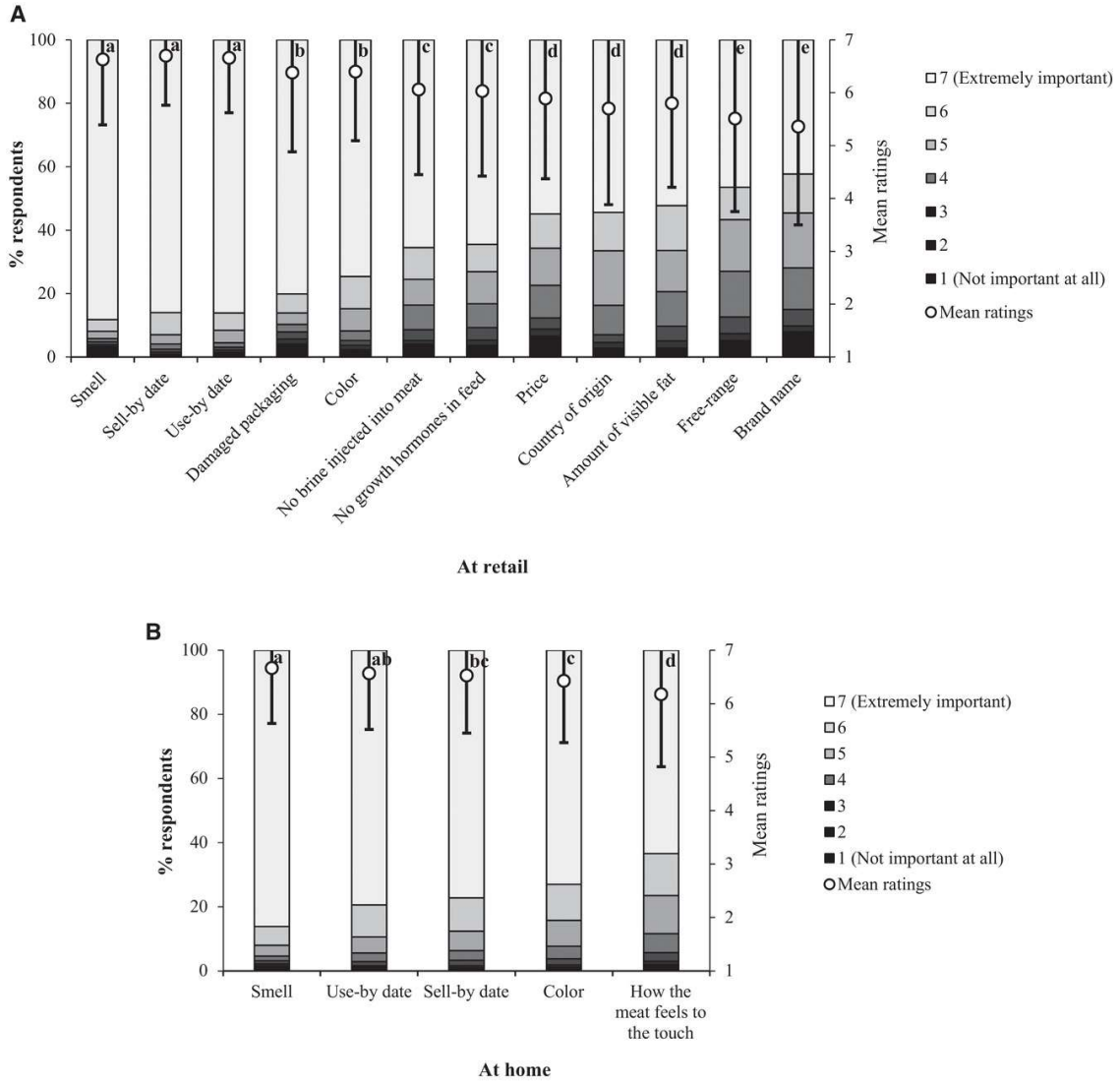

Fig 5. Rating of the importance of attributes of chicken meat when assessed by consumers for quality at retail (A) and home (B). Attributes of chicken meat were rated from 1 (not important at all) to 7 (extremely important). An attribute with the highest mean rating is more important. Mean ratings with different letters are significantly different (Friedman's test, $P < 0.05$, $n = 863$).

Smell, use-by date, and sell-by date were rated equally and highly important for judging quality at point of purchase ($p<0.05$), with mean ratings almost 7 (>6.6) (Figure 5A). More than 80% of the respondents rated these three attributes as extremely important. Damaged packaging and color were rated as the next important attributes, followed by no brine injected into meat and no growth hormones in feed. Brand name and free-range were considered less important. When assessing chicken meat quality before preparation at the home, the respondents rated smell and use-by date as extremely important and how the meat feels to the touch as less important (Figure 5B).

Consumer clustering based on perceptions of chicken meat

For both safety at retail and the home, 3 consumer clusters were identified (Table 1). See Table 2 for a summary of the socio-demographic characteristics of the different clusters. For safety at retail, cluster 1 (37% of consumers) considered smell and use-by date as the most important characteristics, consumers in cluster 2 (30%) ranked packaging integrity, use-by date and country of origin as the most important, while sell-by date was assigned the highest importance by consumers in cluster 3 (33%). About a third of the consumers were in each cluster, with significant cluster number differences identified only for females and consumers aged 30 - 39 years. For safety at home, cluster 1 (40% of consumers) attached more importance to use-by date, cluster 2 (35 %) considered smell and texture as most important, while smell was most important to cluster 3 consumers (25%). In general and per socio-demographic category, the % of consumers in Clusters 1 and 2 were fairly similar but significantly larger than the % in cluster 3 (Table 2).

Table 1 – Rank order of importance of attributes of chicken meat when assessed for safety at retail and home (*n* = 863)

Rank order	At retail[1]			At home[1]		
	Cluster 1 (*n* = 318)	Cluster 2 (*n* = 258)	Cluster 3 (*n* = 287)	Cluster 1 (*n* = 344)	Cluster 2 (*n* = 303)	Cluster 3 (*n* = 216)
Most important	Smell, use-by date	Damaged packaging, use-by date, country of origin	Sell-by date	Use-by date	Smell, how it feels to the touch	Smell
	Color	Smell, brand name, price, no growth hormones in feed, no brine injected into meat, sell-by date	Smell	Smell, sell-by date	Color	Color
	Sell-by date	Color, amount of visible fat	Price	Color	Sell-by date, use-by date	Sell-by date, use-by date
	Damaged packaging	Free-range	Use-by date, color	How it feels to the touch		How it feels to the touch
	No growth hormones in feed, no brine injected into meat		Damaged packaging, brand name, no brine injected into meat			
	Amount of visible fat, country of origin		Amount of visible fat, free-range, no growth hormones in feed			
	Free-range, price		Country of origin			
Least important	Brand name					

[1]At retail, attributes of chicken meat were ranked from 1 for the attribute considered most important to 12 for the attribute considered least important. At home, they were ranked from 1 for the attribute considered most important to 5 for the attribute considered least important. Attributes on different levels of importance are significantly different (ANOVA, $p<0.05$).

Table 2 – Socio-demographic cluster profiles for perceptions of the safety of chicken meat at retail and home (*n* = 863)

Socio-demographic factors	Categories (*n*)	At retail[1]			At home[1]		
		Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3
		318[a] (37)	258[b] (30)	287[ab] (33)	344[a] (40)	303[a] (35)	216[b] (25)
Gender[2]	Male (*n* = 247)	72[a] (29)	86[a] (35)	89[a] (36)	93[a] (38)	96[a] (39)	58[b] (23)
	Female (*n* = 612)	245[a] (40)	170[b] (28)	197[ab] (32)	249[a] (41)	206[a] (34)	157[b] (26)
Age	18 - 29 (*n* = 360)	120[a] (33)	121[a] (34)	119[a] (33)	157[a] (44)	118[ab] (33)	85[b] (24)
	30 - 39 (*n* = 183)	75[a] (41)	47[b] (26)	61[ab] (33)	70[a] (38)	53[a] (29)	60[a] (33)
	40 - 49 (*n* = 137)	52[a] (38)	36[a] (26)	49[a] (36)	48[ab] (35)	58[a] (42)	31[b] (23)
	50 - 59 (*n* = 114)	44[a] (39)	38[a] (33)	32[a] (28)	44[a] (39)	47[a] (41)	23[b] (20)
	60 and older (*n* = 69)	27[a] (39)	16[a] (23)	26[a] (38)	25[a] (36)	27[a] (39)	17[a] (25)
Education level[3]	High school (*n* = 386)	136[a] (35)	116[a] (30)	134[a] (35)	149[a] (39)	141[a] (37)	96[b] (25)
	Tertiary (*n* = 473)	181[a] (38)	141[a] (30)	151[a] (32)	192[a] (41)	161[a] (34)	120[b] (25)

[1]Cluster data presented as *n* (% of respondents). Total % per category may not add up to 100 due to rounding off of figures. Values in a row with different superscripts are significantly different (chi-square test, $p<0.05$).
[2]Consumers who preferred not to disclose their gender (1%) were not included in the statistical analyses.
[3]Consumers with primary school education (1%) were not included in the statistical analyses.

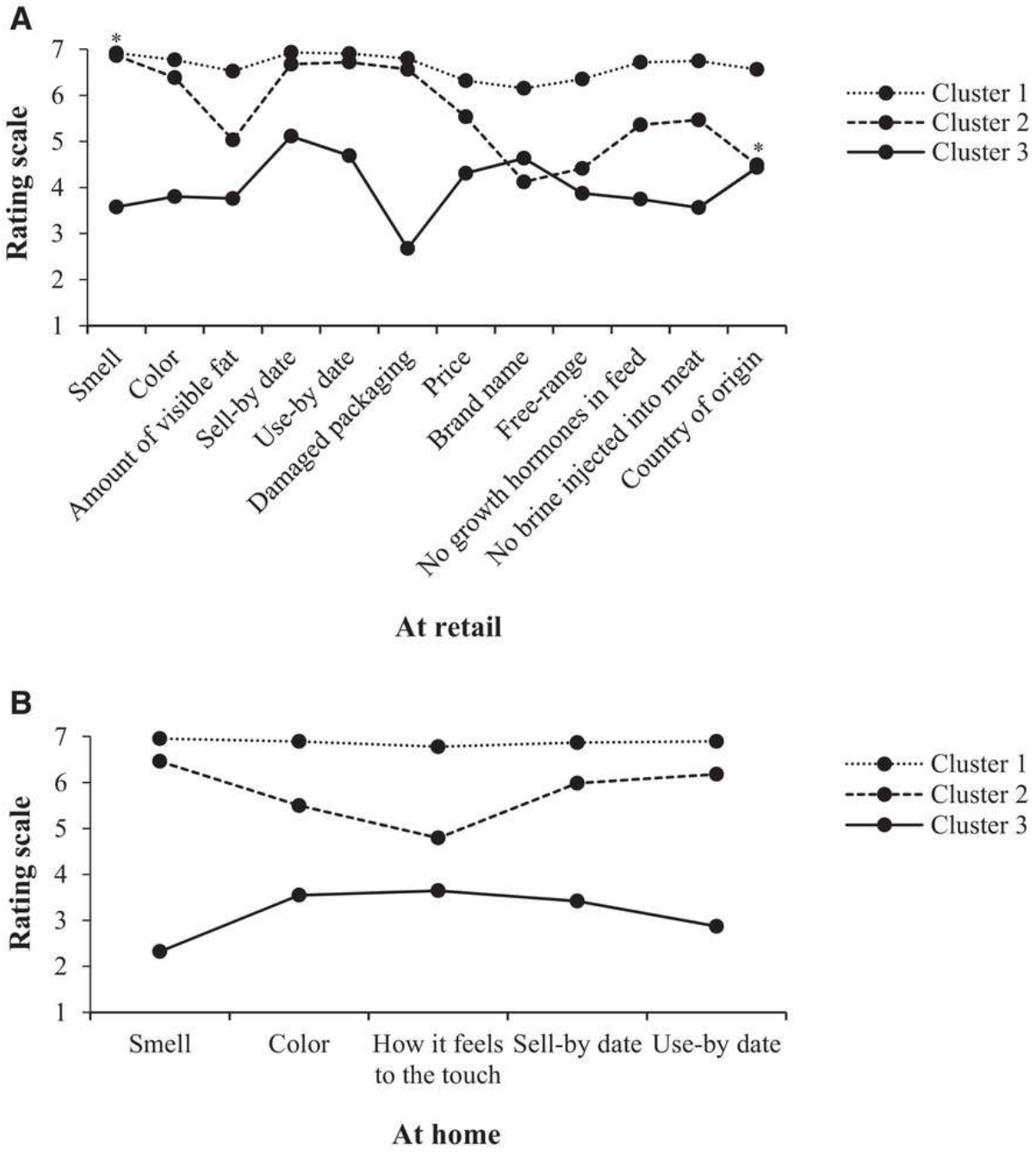

Fig. 6. Consumer clustering based on importance rating of attributes of chicken meat when assessed for quality at retail (A) and home (B). Attributes of chicken meat were rated from 1 (not important at all) to 7 (extremely important). An attribute with the highest mean rating is more important. Mean ratings without an asterisk (*) were significantly different (ANOVA, $P < 0.05$, $n = 863$).

Table 3 – Socio-demographic cluster profiles for perceptions of the quality of chicken meat at retail and home (*n* = 863)

Socio-demographic factors	Categories (*n*)	At retail[1]			At home[1]		
		Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3
		507[a] (59)	285[b] (33)	71[c] (8)	619[a] (72)	213[b] (25)	31[c] (4)
Gender[2]	Male (*n* = 247)	117[a] (47)	95[a] (38)	35[b] (14)	153[a] (62)	78[b] (32)	16[c] (6)
	Female (*n* = 612)	389[a] (64)	188[b] (31)	35[c] (6)	463[a] (76)	134[b] (22)	15[c] (2)
Age	18 - 29 (*n* = 360)	177[a] (49)	134[b] (37)	49[c] (14)	239[a] (66)	99[b] (28)	22[c] (6)
	30 - 39 (*n* = 183)	109[a] (60)	60[b] (33)	14[c] (8)	133[a] (73)	47[b] (26)	3[c] (2)
	40 - 49 (*n* = 137)	89[a] (65)	48[b] (35)	-	100[a] (73)	35[b] (26)	2[c] (1)
	50 - 59 (*n* = 114)	83[a] (73)	24[b] (21)	7[c] (6)	93[a] (82)	18[b] (16)	3[c] (3)
	60 and older (*n* = 69)	49[a] (71)	19[b] (28)	1[c] (1)	54[a] (78)	14[b] (20)	1[c] (1)
Education level[3]	High school (*n* = 386)	224[a] (58)	123[b] (32)	39[c] (10)	284[a] (74)	86[b] (22)	16[c] (4)
	Tertiary (*n* = 473)	281[a] (59)	161[b] (34)	31[c] (7)	333[a] (70)	126[b] (27)	14[c] (3)

[1]Cluster data presented as *n* (% of respondents). Total % per category may not add up to 100 due to rounding off of figures. Values in a row with different superscripts are significantly different (chi-square test, $p<0.05$).
[2]Consumers who preferred not to disclose their gender (1%) were not included in the statistical analyses.
[3]Consumers with primary school education (1%) were not included in the statistical analyses.

For both quality perception at retail and the home, 3 clusters of consumers were identified (Figure 6). The socio-demographic characteristics of the clusters are summarized in Table 3. At retail, the consumers in cluster 1 (almost 60% of respondents) considered all the attributes of chicken meat as extremely important (Figure 6A). Cluster 2 (33% of consumers) rated freshness indicators of chicken meat (smell, color, use-by date, sell-by date) and packaging integrity as extremely important and the rest of the attributes of low importance. The consumers in cluster 3 (8%) rated all attributes of low importance ($p<0.05$). For the different socio-demographic categories, the majority of the consumers were in cluster 1 significantly more than the % in cluster 2 with the smallest % in cluster 3 (Table 3). Similar results were obtained for perceptions of the quality of chicken meat at home (Figure 6B). Respondents in cluster 1, the largest group (Table 3), considered all attributes as extremely important, while those in cluster 2 rated smell and date labels more important than color and texture (Figure 6B). The remaining 4% of the respondents (cluster 3, the smallest %) rated all the attributes low (mean<4) ($p<0.05$).

Discussion

Purchasing and consumption habits

This study substantiates reports that chicken meat is widely consumed in South Africa. Many consumers mostly buy raw chicken for preparation in their households at supermarkets, in a refrigerated or frozen state. In a similar South African study (n=466), Xazela, Hugo, Marume, and Muchenje (2017) also found that a high proportion of consumers from the Eastern Cape province (65%) most often buy meat at supermarkets. Supermarkets are most popular probably because they dominate about 65% of the South African meat market (Ncube, 2018). Moreover, supermarkets offer convenience regarding location and availability of a broad range of groceries, the 'one-stop-shop' concept (D'Haese & Van Huylenbroeck, 2005), compared

with other meat retailers such as butcheries and farmers' markets. Information about the number of butcheries and farmers' markets in South Africa is limited. The most cited reasons by consumers from Gauteng province in South Africa for not frequenting farmers' markets for vegetables, fruits, meat, eggs, and dairy foods were that they were inconveniently located and occurred irregularly (Vermeulen & Biénabe, 2010). These could also be the reasons why many consumers in this study do not mostly purchase chicken meat at farmers' markets. Likewise, many consumers did not purchase chicken meat at wholesalers. It is possible that a substantial number of the consumers were single or do not have big families since many (63%) were aged 18-39 years, and hence may not buy chicken meat in quantities in excess of a few kilograms. No information on the respondents' marital and family status was collected, however. It is also reasonable to assume that many of the respondents were middle and high-income earners since only a few mostly purchase chicken meat from informal retailers (street vendors and 'other retailers') and chicken meat sold at room temperature. Meat from the informal sector is relatively affordable hence it is an essential retail channel in South Africa, particularly to low-income earners in townships and informal settlements (Willemse, 2011). Informal retailers usually sell food products that are neither frozen nor refrigerated, even if the goods are perishable. No information on consumers' household income was collected, however.

Perceptions of the safety of chicken meat

The findings indicate that many consumers considered supermarkets as the most trusted outlets to sell safe chicken meat. A focus group study by Behrens et al. (2010) revealed that supermarkets were most trusted by Brazilian consumers as well because standards of cleanliness and hygiene were viewed as high. This could mean that most consumers equate the cleanliness and hygiene standards of a meat retail outlet with safety of the products on sale. In another study, Verbeke and Ward (2006) found that certification of meat products found in

supermarkets has a positive impact on Belgian consumers' perceptions. Consumers may feel confident of the safety of chicken meat from supermarkets due to guarantee seals which are used as proof by processors that the meat was inspected by authorized government veterinarians and certified. In South Africa, according to the Meat Safety Act, it is mandatory that poultry carcasses be inspected for disease conditions and abnormalities during processing (DAFF, 2006). Before leaving the abattoir, each poultry product is sealed with a label approving that it is fit for human consumption (DAFF, 2006). Nevertheless, it is important to highlight that certification labels do not reflect the microbial status of poultry products, a fact which most consumers may be unaware of. Therefore, it is possible for chicken meat from supermarkets to contain high levels of pathogenic bacteria, with the potential of causing foodborne illnesses if improperly handled.

A few respondents most trusted street vendors and chicken meat sold at room temperature to be safe. Meat from informal retailers is generally considered as posing health risks to consumers. Focus group discussions by Oguttu, McCrindle, Makita, and Grace (2014) with chicken meat street vendors in Gauteng province in South Africa revealed that the vendors sometimes obtained live broiler chickens directly from farmers and slaughtered and dressed them at their homes before selling to consumers. The hygiene conditions during chicken slaughter and vending might not meet specifications in the Meat Safety Act, hence the meat is potentially unsafe. Moreover, the street vending environment usually does not permit maintenance of the cold chain. Frozen or refrigerated chicken meat is thus relatively safe because the maintenance of cold temperatures at retail ensures no or minimal bacterial growth. In cases whereby consumers purchase live chicken for slaughter at home, there could also be a microbial risk especially when the intestinal contents contaminate the meat during evisceration of the carcasses and if the chicken slaughter waste is not properly disposed of. It is therefore

paramount to raise consumer awareness of food safety practices, irrespective of their perceptions of chicken meat retailers.

The majority of consumers tend to rely on freshness indicators for assessing chicken meat safety during purchasing and preparation. Smell, use-by and sell-by dates, and color were ranked as more important indicators. Use-by date refers to "the date which signifies the end of the period under any stated storage conditions, after which the product should not be sold or consumed due to safety and quality reasons" (FAO/WHO, 2018). It has been cautioned that use-by dates do not guarantee meat safety because the maintenance of cold temperatures along the supply chain cannot be assured (Newsome et al., 2014). Recent allegations of date label alterations to extend the shelf life of meat could further increase this safety risk (Times LIVE, 2017, 2019). Smell and color are considered as inaccurate indicators of the microbial safety of meat because bacterial pathogen growth does not result in sensory changes in meat and can cause human illnesses at low concentrations, even when the meat is unspoiled (Henson & Northen, 2000). Consequently, it is essential that consumers practice food safety from point of purchase to consumption at the home, regardless of date labels and sensory characteristics of chicken meat.

Consumers also perceived the absence of growth hormones in chicken feed to be an important attribute when judging safety. The use of hormonal substances as growth promoters in food animals has provoked many concerns regarding the impact on human health (Jeong, Kang, Lim, Kang, & Sung, 2010). It is possible that some consumers assume that the feed of commercially farmed chickens contains growth-promoting hormones. This misconception could have arisen from the fact that the use of growth-promoting hormones is permitted in the beef industry (DAFF, 2008), and some chicken products are marketed as "raised without growth-promoting hormones". The use of growth-promoting hormones in chicken farming is not allowed in South Africa and thus is not stipulated in the food labeling and advertising

regulations (DAFF, 2008; Department of Health, 2014b). The label claims may result in consumers supposing that all chicken products without this claim are being raised using growth-promoting hormones. In the USA, this claim is permitted only if it is accompanied by a statement informing consumers that the use of hormones in the production of poultry is prohibited (Yang, Raper, & Lusk, 2017). To address consumer concerns, the poultry industry should increase efforts to inform consumers of this aspect. Moreover, it is advisable that food regulators monitor product labels at retail to protect consumers against misleading claims.

For transparency and traceability purposes it is mandatory for processors to declare on packaging where chicken meat products were produced, processed or packaged. Some developed countries such as Australia also require country of origin labelling (Country of Origin Food Labelling Information Standard, 2016). This regulation is even more critical in South Africa now that chicken meat imports have increased substantially as a consequence of shortfalls in local production (SAPA, 2018). Of interest in this study were consumers' safety perceptions of the country of origin following allegations of unsanitary practices by some Brazilian chicken processors (DAFF, 2017). The scandal generated substantial media publicity because Brazil is a major suppliers of raw chicken meat (SAPA, 2018). Overall, country of origin was considered as one of the least important attributes when inferring safety of chicken meat. However, a substantial proportion of consumers (30 %) considered country of origin, packaging integrity and texture as most important. Verbeke and Ward (2006) also found the importance of country of origin of meat to be lower compared to other attributes. The origin of chicken meat has been increasingly regarded by European consumers as an important safety cue, with the majority buying meat of domestic origin (Vukasovic, 2011). It was noted that geographical origin is highly influential on consumers' purchasing decisions especially during meat safety crises such as avian influenza outbreaks. The surface texture of raw chicken meat

deteriorates at advanced stages of microbial spoilage (Russel, 2010), hence this attribute may not be as reliable as smell.

In the USA and Australia, consumers perceived free-range chicken to be safer than conventional chicken as they believed that less/no growth-promoting hormones and antibiotics were used during its production, and the prevalence of pathogenic bacteria was lower (Bernard, Pesek, & Pan, 2007; Erian & Phillips, 2017). In the present study, free-range was one of the least important attributes when assessing chicken meat safety. In South Africa, there is currently no legislated national standard governing free-range chicken farming (Tung, 2016). There is presently no data (according to our knowledge) to indicate if consumers of free-range chicken are aware of this fact, their expectations and understanding of free-range chicken, and even the actual production practices by farmers. Though considered less important, it is advisable to promulgate production regulations to guarantee the authenticity of free-range products and for consumer protection.

Perceptions of the quality of chicken meat

Consistent with supermarkets being the most frequented retailers for raw chicken meat by consumers, the outlets were also the most trusted to sell good quality chicken. A study by Behrens et al. (2010) reported that supermarkets are usually preferred rather than informal retailers because consumers trust that the meat is sourced from reputable suppliers and hence would have been produced and processed following stipulated regulations, including labeling. However, other studies found that consumers frequent butcheries (McCarthy & Henson, 2005), wet markets and farmers' markets (Chamhuri & Batt, 2013) more as they perceived the meat to be freshly slaughtered and thus of better quality in comparison with that from supermarkets. The reported differences could be partly due to dissimilar chicken meat market structures among countries. Although frozen chicken meat is generally lower priced, more consumers

most trusted refrigerated chicken meat to be of good quality than those who most trusted frozen chicken. Frozen chicken meat accounts for about 70% of all retail chicken meat sales in South Africa (NAMC, 2018). Consumers may not prefer frozen chicken products as they are usually injected with brine during processing. Another possible reason could be that consumers may find it easier to detect irregularities in the color and smell of chicken meat when it is sold in a refrigerated rather than frozen state.

Here, smell, use-by and sell-by dates were rated as highly important attributes, followed by color for assessing quality of chicken meat at retail and before preparation at the home. Visual appearance is an important meat attribute at retail probably because consumers use color as an indicator of freshness/spoilage (Kennedy, Stewart-Knox, Mitchell, & Thurnham, 2004; Skunca et al., 2016). The visual appearance of chicken meat includes skin color, flesh color and any defects such as bruises and blood clots. Chicken meat is perishable and loss of freshness during storage is mainly caused by bacterial growth (Rukchon, Nopwinyuwong, Trevanich, Jinkarn, & Suppakul, 2014). In this study, the smell of chicken meat at point of purchase was considered highly important. In South Africa, meat on display in butchery sections or markets can be sold unpackaged. Consumers may be able to detect spoilage odors emanating from the meat or facilities during purchasing, causing them not to buy it even if the color and overall appearance are still acceptable. In such cases, the appearance may become secondary to smell.

Date labels, irrespective of their meaning, generally give consumers confidence in the quality of meat products (Verbeke & Ward, 2006). Though use-by and sell-by dates are good indicators of meat freshness, they may not be helpful to consumers when the cold chain is broken. Some researchers have proposed using intelligent packaging to monitor bacterial deterioration and communicate quality status to consumers (Yam, Takhistov, & Miltz, 2005). Surprisingly the sell-by date was considered of high importance by consumers when assessing

the quality of chicken meat before preparation at home. One would expect that the sell-by date would not matter anymore. This could suggest that many consumers may be unaware of what the sell-by date indicates. The sell-by date is "the last date of offer for sale to the consumer after which there remains a reasonable storage period at home" (Department of Health, 2014a). It is highly probable that many consumers confuse sell-by, use-by and expiry dates. Leib et al. (2014) proposed that sell-by dates on food products are mainly for stock control by retail personnel and should be incomprehensible or invisible to consumers as they may be incorrectly interpreted. Misinterpretation of date labels by consumers could result in food loss. Consumers could benefit from education about date labeling terminology to improve quality assessment of food products.

Brining of chicken meat to enhance its flavor and tenderness during cooking has been practiced by poultry processors for many years in South Africa (Tan, De Kock, Dykes, Coorey, & Buys, 2018). In developed countries such as the USA, injection of flavor enhancers into poultry meat is also allowed (United States Department of Agriculture, 1999). However, in South Africa, there were disagreements between local processors and regulators concerning appropriate chicken brine injection levels (South African Poultry Association v. Minister of Agriculture, 2016). Some reports highlighted that high salt concentrations in brine could put consumers' health at risk, hence non-brined chicken meat could be healthier (Mashishi, 2016). The brining limits were eventually set at 10% and 15% for whole chicken carcasses and portions, respectively (DAFF, 2016). Despite controversy and extensive media coverage concerning the brining of chicken meat, there is to date no published research (according to our knowledge) giving insight on consumers' perceptions and expectations regarding brined chicken. This study indicates that consumers perceived the absence of brine in chicken meat as an important attribute reflecting its quality and safety. It is advisable for poultry processors to conduct market research and incorporate consumers' views regarding brining of chicken meat.

In other developing countries e.g. Zambia, brining of chicken meat is not practiced as this is what consumers prefer. Zambian consumers perceive non-brined chicken meat as 'wholesome' (Bagopi et al., 2014).

Price, visible fat content and country of origin appeared to be of low importance for evaluating quality during purchasing. This study did not explore the economic status of respondents, but it is reasonable to assume that price would be important to consumers with low educational background and income. Visible fat content may not be a quality issue for consumers because some processors in South Africa trim off excess fat from raw chicken and label the products as such. To Belgian consumers, the importance of country of origin was lower than that of other extrinsic attributes of chicken meat (Verbeke and Ward, 2006). In contrast, Ehmke, Lusk, and Tyner (2008) revealed that consumers from China, Niger, France and the USA generally prefer meat products from their own countries, suggesting ethnocentric tendencies.

Brand name and free-range were considered the least important attributes. Possibly the quality of chicken meat is a generic concept to consumers and not brand specific. In Brazil (Farina & de Almeida, 2003) and Vietnam (Ifft, Roland-Holst, & Zilberman, 2012), free-range chicken meat was perceived to be tastier, healthier and more natural, key quality considerations. As previously discussed, South African consumers may not find free-range highly important due to a limited knowledge about the concept.

The majority of consumers perceived intrinsic and extrinsic attributes of chicken meat to be important for assessing quality. Research suggests that consumers who value attributes of meat tend to be more involved with the product and invest more cognitive effort into the decision-making process (Ripoll & Panea, 2019). High involvement leads to an extensive search and use of product information before decision-making. Another cluster of consumers, seemed to value intrinsic attributes more than extrinsic ones. Roe and Bruwer (2017) proposed

that consumers with high meat product involvement rely on intrinsic rather than extrinsic attributes.

Conclusions

Although smell, use-by dates, and color are good indicators of the quality of chicken meat, they do not reflect the presence or levels of bacterial pathogens in chicken meat which can cause foodborne illnesses even when the meat is unspoiled. Since human pathogenic bacteria are almost always present in raw chicken, knowledge about microbial risks and safe handling practices for chicken meat needs to be communicated effectively to reduce or eliminate risks at the consumer level. Consumer education on the correct interpretation of date labels is also recommended. The findings also suggest that chicken industry stakeholders revisit the issue of brining of chicken meat from a consumer preference perspective, and also address the misconceptions about the use of growth-promoting hormones by raising consumer knowledge on chicken production. Consumers should not be misled by 'raised without growth-promoting hormones' claims. The information from this study can assist public health authorities to design targeted food safety awareness programs and the chicken industry to meet consumer expectations. A limitation is that study participants do not represent the total chicken consuming market and lower income consumers were probably underrepresented. Further research should also focus on this group.

Acknowledgments

This work is based on the research supported in part by the National Research Foundation (NRF) for a scholarship for W. Katiyo (Grant Number: 116440), and Australia-Africa Universities Network (AAUN). Opinions expressed and conclusions arrived at, are those of the authors and are not necessarily to be attributed to NRF or AAUN.

Author Contributions

W. Katiyo designed the study, collected survey data, performed statistical analyses, interpreted the results and drafted the manuscript. H.L. de Kock and R. Coorey contributed as research co-supervisors and E.M. Buys as the main supervisor.

References

Bagopi, E., Chokwe, E., Halse, P., Hausiku, J., Humavindu, M., Kalapula, W., & Roberts, S. (2014, April). Competition dynamics and regional trade flows in the poultry sector: The case of South Africa, Botswana, Namibia, and Zambia. *Paper presented at the meeting of Pre-International Competition Network Forum,* Marrakesh, Morocco.

Becker, T., Benner, E., & Glitsch, K. (2000). Consumer perception of fresh meat quality in Germany. *British Food Journal, 102*(3), 246-266.

Behrens, J. H., Barcellos, M. N., Frewer, L. J., Nunes, T., Franco, B. D., Destro, M. T., & Landgraf, M. (2010). Consumer purchase habits and views on food safety: A Brazilian study. *Food Control, 21*(7), 963-969.

Bernard, J. C., Pesek, J. D., & Pan, X. (2007). Consumer likelihood to purchase chickens with novel production attributes. *Journal of Agricultural and Applied Economics, 39*(3), 581-596.

Bureau for Food and Agricultural Policy/National Agricultural Marketing Council (BFAP/NAMC). (2018). *Evaluating the competitiveness of the South African broiler value chain*. Retrieved from http://www.bfap.co.za/wp-content/uploads/reports/Evaluating%20the%20competitiveness%20of%20the%20South%20African%20broiler%20value%20chain_final%20Report_low%20res.pdf, Accessed date: 16 January 2019.

Borgogno, M., Favotto, S., Corazzin, M., Cardello, A. V., & Piasentier, E. (2015). The role of product familiarity and consumer involvement on liking and perceptions of fresh meat. *Food Quality and Preference, 44*, 139-147.

Chamhuri, N., & Batt, P. (2013). Exploring the factors influencing consumers' choice of retail store when purchasing fresh meat in Malaysia. *International Food and Agribusiness Management Review, 16*(3), 99-122.

Codex Alimentarius Commission. (2005). Code of hygienic practice for meat. *Codex Document CAC/RCP 58-2005*. Rome: FAO/WHO.

Country of Origin Food Labelling Information Standard. (2016). *section 134 of Schedule 2 of the Competition and Consumer Act 2010, Australia*. Retrieved from

https://www.legislation.gov.au/Details/F2017C00920Competition, Accessed date: 20 June 2019.

D'Haese, M., & Van Huylenbroeck, G. (2005). The rise of supermarkets and changing expenditure patterns of poor rural households case study in the Transkei area, South Africa. *Food Policy, 30*(1), 97-113.

Department of Agriculture, Forestry and Fisheries (DAFF). (2006). Meat Safety Act 2000, (Act No. 40 of 2000). *Government Gazette (No. 8402)*. Pretoria: Government Printing Works.

Department of Agriculture, Forestry and Fisheries (DAFF). (2008). Fertilisers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 (Act No. 36 of 1947). *Government Gazette (No. 31005)*. Pretoria: Government Printing Works.

Department of Agriculture, Forestry and Fisheries (DAFF). (2016). Agricultural Product Standard Act, 1990 (Act No. 119 of 1990) Amendment *Government Gazette (No. 39944)*. Pretoria: Government Printing Works.

Department of Agriculture, Forestry and Fisheries (DAFF). (2017). *Media statement - DAFF suspends meat imports from establishments suspected to be involved in Brazil meat scandal*. Retrieved from https://www.nda.agric.za/docs/media/Media%20Statement%20-%20DAFF%20suspends%20meat%20imports%20from%20establishments%20suspected%20to%20be%20involved%20in%20Brazil%20Meat%20Scandal.pdf, Accessed date: 16 February 2019.

Department of Health. (2014a). Foodstuffs, Cosmetics and Disinfectants Act, 1972 (Act 54 of 1972): Regulations relating to the labelling and advertising of foods: Amendment. *Government Gazette (No. 37695)*. Pretoria: Government Printing Works.

Department of Health. (2014b). *Draft guidelines, Labelling and advertising of foods (R429 of 29 May 2014), for compliance purposes*. Retrieved from http://www.sapoultry.co.za/pdf-docs/Food-labelling-Guidelines.pdf, Accessed date: 28 March 2019.

Djekic, I., Skunca, D., Nastasijevic, I., Tomovic, V., & Tomasevic, I. (2018). Transformation of quality aspects throughout the chicken meat supply chain. *British Food Journal, 120*(5), 1132-1150.

Donelan, A. K., Chambers, D. H., Chambers IV, E., Godwin, S. L., & Cates, S. C. (2016). Consumer poultry handling behavior in the grocery store and in-home storage. *Journal of Food Protection, 79*(4), 582-588.

Ehmke, M. D., Lusk, J. L., & Tyner, W. (2008). Measuring the relative importance of preferences for country of origin in China, France, Niger, and the United States. *Agricultural Economics, 38*(3), 277-285.

Erian, I., & Phillips, C. (2017). Public understanding and attitudes towards meat chicken production and relations to consumption. *Animals, 7*(3), 20.

Food and Agricutural Organization/World Health Organization (FAO/WHO). (2018). General standard for the labelling of prepackaged food, revision. *(CXS-1985)*. Rome: FAO/WHO.

Farina, T. M., & de Almeida, S. F. (2003). Consumer perception on alternative poultry. *International Food and Agribusiness Management Review, 2*(5), 1-14.

Font-i-Furnols, M., & Guerrero, L. (2014). Consumer preference, behavior and perception about meat and meat products: An overview. *Meat Science, 98*(3), 361-371.

Glitsch, K. (2000). Consumer perceptions of fresh meat quality: cross-national comparison. *British Food Journal, 102*(3), 177-194.

Henson, S., & Northen, J. (2000). Consumer assessment of the safety of beef at the point of purchase: a pan-European study. *Journal of Agricultural Economics, 51*(1), 90-105.

Ifft, J., Roland-Holst, D., & Zilberman, D. (2012). Consumer valuation of safety-labeled free-range chicken: results of a field experiment in Hanoi. *Agricultural Economics, 43*(6), 607-620.

Imran, S., Kamarulzaman, N., Latif, I., & Mohd Nawi, N. (2014). Enhancing poultry industry competitiveness: Consumer perspective on chicken meat quality based on sensory characteristics. *Journal of Food Products Marketing, 20*(sup1), 102-121.

Jeong, S. H., Kang, D., Lim, M. W., Kang, C. S., & Sung, H. J. (2010). Risk assessment of growth hormones and antimicrobial residues in meat. *Toxicological Research, 26*(4), 301.

Joo, S., Kim, G., Hwang, Y., & Ryu, Y. (2013). Control of fresh meat quality through manipulation of muscle fiber characteristics. *Meat Science, 95*(4), 828-836.

Katiyo, W., de Kock, H. L., Coorey, R., & Buys, E. M. (2019). Assessment of safety risks associated with handling chicken as based on practices and knowledge of a group of South African consumers. *Food Control, 101,* 104-111.

Kennedy, O., Stewart-Knox, B., Mitchell, P., & Thurnham, D. (2004). Consumer perceptions of poultry meat: a qualitative analysis. *Nutrition and Food Science, 34*(3), 122-129.

Koppel, K., Timberg, L., Shalimov, R., Vázquez-Araújo, L., Carbonell-Barracchina, A. A., Di Donfrancesco, B., & Chambers IV, E. (2015). Purchase, storage, and preparation of eggs and poultry in selected European countries: A preliminary study. *British Food Journal, 117*(2), 749-765.

Kosa, K. M., Cates, S. C., Bradley, S., Chambers IV, E., & Godwin, S. (2015). Consumer-reported handling of raw poultry products at home: results from a national survey. *Journal of Food Protection, 78*(1), 180-186.

Leib, E. B., Gunders, D., Ferro, J., Nielsen, A., Nosek, G., & Qu, J. (2014, November). The dating game: How confusing food date labels lead to food waste in America. *Paper presented at the American Public Health Association Annual Meeting and Exposition,* New Orleans, LA, USA.

Ligthelm, A. (2013). Confusion about entrepreneurship? Formal versus informal small businesses. *Southern African Business Review, 17*(3), 57-75.

Liu, L., Peng, Z., Wu, H., Jiao, H., Yu, Y., & Zhao, J. (2018). Fast identification of urban sprawl based on K-means clustering with population density and local spatial entropy. *Sustainability*, *10*(8), 2683.

Magwedere, K., Rauff, D., De Klerk, G., Keddy, K. H., & Dziva, F. (2015). Incidence of nontyphoidal Salmonella in food-producing animals, animal feed, and the associated environment in South Africa, 2012–2014. *Clinical Infectious Diseases, 61*(suppl. 4), S283-S289.

Mashishi, M. D. (2016). *Determination of optimal brining levels and effective chlorinated antimicrobials in three selected commercial poultry abattoirs of South Africa.* MSc thesis: University of South Africa. Pretoria, South Africa.

McCarthy, M., & Henson, S. (2005). Perceived risk and risk reduction strategies in the choice of beef by Irish consumers. *Food Quality and Preference, 16*(5), 435-445.

McCarthy, M., O'Reilly, S., Cotter, L., & de Boer, M. (2004). Factors influencing consumption of pork and poultry in the Irish market. *Appetite, 43*(1), 19-28.

National Agricultural Marketing Council (NAMC). (2018). *Food basket price monthly, May 2018*. Retrieved from https://www.namc.co.za/wp-content/uploads/2018/05/NAMC-Food-Basket-Price-Monthly-May-2018.pdf, Accessed date: 9 February 2019.

Ncube, P. (2018). The southern African poultry value chain: Corporate strategies, investments and agro-industrial policies. *Development Southern Africa*, *35*(3), 369-387.

Newsome, R., Balestrini, C., Baum, M., Corby, J., Fisher, W., Goodburn, K., . . . Yiannas, F. (2014). Applications and perceptions of date labelling of food. *Comprehensive Reviews in Food Science and Food Safety, 13*(4), 745-769.

Niehaus, A. J., Apalata, T., Coovadia, Y. M., Smith, A. M., & Moodley, P. (2011). An outbreak of foodborne salmonellosis in rural KwaZulu-Natal, South Africa. *Foodborne Pathogens and Disease, 8*(6), 693-697.

Oguttu, J., McCrindle, C., Makita, K., & Grace, D. (2014). Investigation of the food value chain of ready-to-eat chicken and the associated risk for staphylococcal food poisoning in Tshwane Metropole, South Africa. *Food Control, 45*, 87-94.

Pouta, E., Heikkilä, J., Forsman-Hugg, S., Isoniemi, M., & Mäkelä, J. (2010). Consumer choice of broiler meat: The effects of country of origin and production methods. *Food Quality and Preference, 21*(5), 539-546.

Ripoll, G., & Panea, B. (2019). The effect of consumer involvement in light lamb meat on behavior, sensory perception, and health-related concerns. *Nutrients*, *11*(6), 1200.

Roe, D., & Bruwer, J. (2017). Self-concept, product involvement and consumption occasions: exploring fine wine consumer behaviour. *British Food Journal*, *119*(6), 1362-1377.

Rukchon, C., Nopwinyuwong, A., Trevanich, S., Jinkarn, T., & Suppakul, P. (2014). Development of a food spoilage indicator for monitoring freshness of skinless chicken breast. *Talanta, 130*, 547-554.
Russell, S. M. (2010). Spoilage bacteria associated with poultry. In C. M. Owens, C. Z. Alvarado, & A. R. Sams (Eds.), *Poultry meat processing* (pp. 169-190). Boca Raton: CRC Press.

South African Poultry Association (SAPA). (2018). *Broiler and egg industry stats summary for 2017*. Retrieved from http://www.sapoultry.co.za/pdf-statistics/broiler-egg-stats-summary.pdf, Accessed date: 16 January 2019.

Sepúlveda, W. S., Maza, M. T., & Pardos, L. (2011). Aspects of quality related to the consumption and production of lamb meat. Consumers versus producers. *Meat Science, 87*(4), 366-372.

Sismanoglou, A., & Tzimitra-Kalogianni, I. (2011). Consumer perception of poultry meat in Greece. *World's Poultry Science Journal, 67*(2), 269-276.

Skunca, D., Tomašević, I., Zdolec, N., Kolaj, R., Aleksiev, G., & Djekić, I. (August, 2016). Purchase patterns of chicken meat in Southeast Europe. *Paper presented at the International Congress of Meat Science and Technology*, Bangkok, Thailand.

South African Poultry Association v. Minister of Agriculture. (2016). *ZAGPPHC 862 (21 September 2016) Court case documents no. 39597/2016*. Retrieved from http://www.saflii.org/za/cases/ZAGPPHC/2016/862.pdf, Accessed date: 19 June 2019.

Tan, S., De Kock, H. L., Dykes, G., Coorey, R., & Buys, E. M. (2018). Enhancement of poultry meat: Trends, nutritional profile, legislation and challenges. *South African Journal of Animal Science, 48*(2), 199-212.

Times LIVE. (2017). Meat World in sell-by date turmoil. Retrieved from https://www.timeslive.co.za/news/consumer-live/2017-09-25-meat-world-in-sell-by-date-turmoil/, Accessed date: 15 February 2019.

Times LIVE. (2019). Butchery manager bust adding 'fresh' expiry date to old chickens. Retrieved from https://www.timeslive.co.za/news/consumer-live/2019-01-29-butchery-manager-bust-adding-fresh-expiry-date-to-old-chickens/, Accessed date: 15 February 2019.

Troy, D., & Kerry, J. (2010). Consumer perception and the role of science in the meat industry. *Meat Science, 86*(1), 214-226.

Tung, O. J. L. (2016). Organic food certification in South Africa: a private sector mechanism in need of state regulation? *Potchefstroom Electronic Law Journal, 19*(1).

United States Department of Agriculture (USDA). (1999). FSIS Label Policy Memorandum 042: Ready-to-cook poultry products to which solutions are added. *Code of Federal*

Regulations, Title 9, Chapter III, Part 381, Subpart P, § 381.169. Washington, DC: US Government Printing Office.

Verbeke, W., & Vackier, I. (2004). Profile and effects of consumer involvement in fresh meat. *Meat Science, 67*(1), 159-168.

Verbeke, W., & Ward, R. (2006). Consumer interest in information cues denoting quality, traceability and origin: An application of ordered probit models to beef labels. *Food Quality and Preference, 17*(6), 453-467.

Vermeulen, H., & Biénabe, E. (2010). *Food Quality Behavior, Perceptions and Knowledge of South African Consumers: A Focus on Middle and Upper Socio-economic Groups*. National Agricultural Marketing Council. Retrieved from https://www.namc.co.za/wp-content/uploads/2017/09/Food-Quality-Report.pdf, Accessed date: 22 March 2019.

Vukasovič, T. (2011). The importance of national chicken meat origin in Central and South-Eastern Europe. *World's Poultry Science Journal*, 67(2), 237-242.

Vukasovič, T. (2014). European meat market trends and consumer preference for poultry meat in buying decision making process. *World's Poultry Science Journal, 70*(2), 289-302.

Willemse, L. (2011). Opportunities and constraints facing informal street traders: Evidence from four South African cities. *Town and Regional Planning, 59*, 7-15.

Xazela, N., Hugo, A., Marume, U., & Muchenje, V. (2017). Perceptions of Rural Consumers on the Aspects of Meat Quality and Health Implications Associated With Meat Consumption. *Sustainability, 9*(5), 830.

Yam, K. L., Takhistov, P. T., & Miltz, J. (2005). Intelligent packaging: concepts and applications. *Journal of Food Science, 70*(1), 1-10.

Yang, R., Raper, K. C., & Lusk, J. L. (2017, February). The impact of hormone use perception on consumer meat preference. *Paper presented at the Southern Agricultural Economics Association Annual Meeting,* Mobile, Alabama, USA.