

Literature study on the fat-related preferences of South African consumers

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Executive summary:

The purpose of this report is to present a literature review, as requested by the RMRD SA Planning Committee Cattle and Small Stock in December 2017, to investigate the fat-related preferences of South African consumers.

The report is structured according to a number of key research questions, pertaining to South African consumers' perceptions regarding fat in red meat:

- How important is fat within the larger spectrum of red meat purchasing considerations?
- How important is fat when considering consumers' concerns regarding red meat?
- What do we know about consumers' preferences for the quantity of fat in red meat?
- What do we know about consumers' preferences for the colour of fat in red meat?
- What do we know about consumers' preferences for different types of fat in red meat (e.g. visible fat, marbling)?

Research question 1: How important is fat within the larger spectrum of red meat purchasing considerations?

The dominant factors considered by consumers when purchasing red meat were: Price [see references (2), (3), (6), (14), (17)]; Food safety (including food safety in general, expiry date, sell-by date, clean meat, no blood in packaging) [see references (2), (3), (14), (17)]; General quality and quality guarantee [see references (6), (15), (17)]; Appearance (general appearance, neat packaging, meat cuts, no blood in packaging, meat colour) [see references (3), (4), (6), (15), (17)]; And sensory appeal (taste, juiciness, tenderness) [see references (6), (17)]. It is important to note that the range of factors presented to respondents differed between studies and furthermore that very few of the reviewed consumer studies focused on fat in red meat exclusively. In general, as could be expected, the importance of price decreased towards higher socio-economic levels [see references (2), (6), (15), (17)].

Fat-related attributes were not among the strongly dominant red meat purchasing considerations, but was revealed as having importance to consumers, as illustrated by the following examples: fat and fat distribution scoring an 'importance rating' of 4.1 out of 5 [reference (3)], amount of visible fat scoring an 'importance rating' of 4.1 out of 5 [reference (6)], visible fat distribution scoring an 'importance rating' of 3.9 out of 5 [reference (6)], fat content, fat colour and 'low-fat' perceived as 'very important' by 60% or more of consumers [reference (15) (17)],

A comparison of reviewed literature with consumer research conducted 20 years ago revealed that over time price / affordability and fat content has become relatively more important, while sensory- and visual appeal remained important.

The major research recommendations identified within the literature reviewed for Research Question 1 were:

- Investigate the importance of fat in red meat, as well as consumers' preferences for leaner meat or meat with more fat;
- Distinguish between red meat purchase considerations which could be evaluated before purchase and after consumption.

Research question 2: How important is fat when considering consumers' concerns regarding red meat?

Consumers' concerns pertaining to red meat focused mainly on price / affordability, with some studies revealing health concerns and concerns linked to the fat content of red meat [see references (3), (6), (17), (18)]. Specific examples of health concerns involved cholesterol, heart disease, high blood pressure, gout and diabetes.

The major research recommendations identified within the literature reviewed for Research Question 2 were:

- In-depth consumer research is needed to understand the intricate perceptions and behaviour of consumers regarding fat in red meat and health. There is a need to understand whether health concerns in the context of red meat are related to aspects such as fat content, cancer risk, lifestyle diseases or eating too much meat.

Research question 3: What do we know about consumers' preferences for the quantity of fat in red meat?

The available indicated a range of results, which makes it difficult to compile a consensus summary, for example:

- Middle- and upper-income consumers in Bloemfontein revealed a preference for some external fat on steak [reference (8)];
- Even though lower-income consumers are concerned about fat in red meat [reference (17)], another study found that leaner red meat options were not generally bought by lower-income consumers due to the price premium usually associated with leaner meat cuts [reference (3)].
- An eye-tracking study in the Free State indicated a preference for medium-fat towards lean red meat cuts [reference (1)].
- Studies in Gauteng and the Western Cape indicated that about two thirds of consumers were concerned about the amount of fat in red meat. 'Fat concerned' consumers revealed a higher preference for chicken and a higher tendency to shift some intake of red meat towards alternative animal protein foods options [references (16), (17)].

In recent years, anecdotal evidence has pointed to a rise in the adoption of diets involving higher protein and fat levels among particularly wealthier South African consumers. No literature could be found on consumers fat perceptions in this regard or in terms of the impact it could have on the SA red meat industry.

The major research recommendations identified within the literature reviewed for Research Question 3 were:

- In-depth consumer research is needed to understand the 'direction' of consumers' red meat fat preferences, as well as the relevant motivations and perceptions. It is important to take into consideration different red meat species and cuts, as well as different eating occasions and cooking methods.
- How can leaner red meat cuts be made more affordable to lower-income red meat consumers?
- Quantification of the high fat / high protein diets movement in South Africa and its implications for red meat consumption and fat preferences.

Research question 4: What do we know about consumers' preferences regarding fat colour?

Fat colour seems to be important to consumers, for example 70% to 80% of Western Cape middle-income and affluent consumers perceived fat colour as 'very important' [references (16), (17)]. Only one reviewed study focused specifically on fat colour [reference (3)] showing that 44% of consumers sampled in Cape Town preferred white fat while 42% were indecisive.

The major research recommendations identified within the literature reviewed for Research Question 4 were:

- Consumers' perceptions, knowledge and behaviour pertaining to white fat and yellow fat on red meat should be investigated from a wider geographical focus on a national level – utilising visual cues to probe consumers. There should be a focus on the identification of misconceptions regarding fat colour as well as measuring the potential impact of consumer education on behaviour.
- More research is needed to understanding consumers behaviour and perceptions pertaining to fat colour and animal feeding practices (i.e. grain-fed versus grass-fed).

Research question 5: What do we know about consumers' preferences for different types of fat in red meat (e.g. visible fat, marbling)?

Very little has been done on consumer preferences for different types of fat in red meat. There is some evidence that fat distribution is important to consumers in Cape Town [reference (3)], while another study indicated that marbling fat did not affect the price of beef steaks in Bloemfontein [reference (8)].

The major research recommendations identified within the literature reviewed for Research Question 5 were:

- In-depth consumer research (involving visual aids as cues) is needed to understand consumers' preferences, behaviour and willingness to pay for different types of fat in red meat.

The report concludes with a detailed description of research recommendations, elaborating on the aspects mentioned in the executive summary.

1. Introduction:

In addition to animal age, fat content is an important component within the South African Red Meat Classification system, with fat classified from zero (no fat) to 6 (class with highest fat content). As a result of consumer demand, the fat content of South African red meat has already decreased to less than 10 g per 90 g portion through breeding, farming and butchering techniques (Schönfeldt & Hall, 2008). The fat content of lean red meat compares favourably to other animal source foods including chicken (with, or without the skin) (Schönfeldt, *et al.*, 2013). Considering slaughtering statistics for 2017 as published by the Red Meat Abattoir Association (RMAA) (RPO, 2018) (aggregated from weekly data), fat class 2 dominates for both beef and lamb/sheep (see Figures 1 and 2)

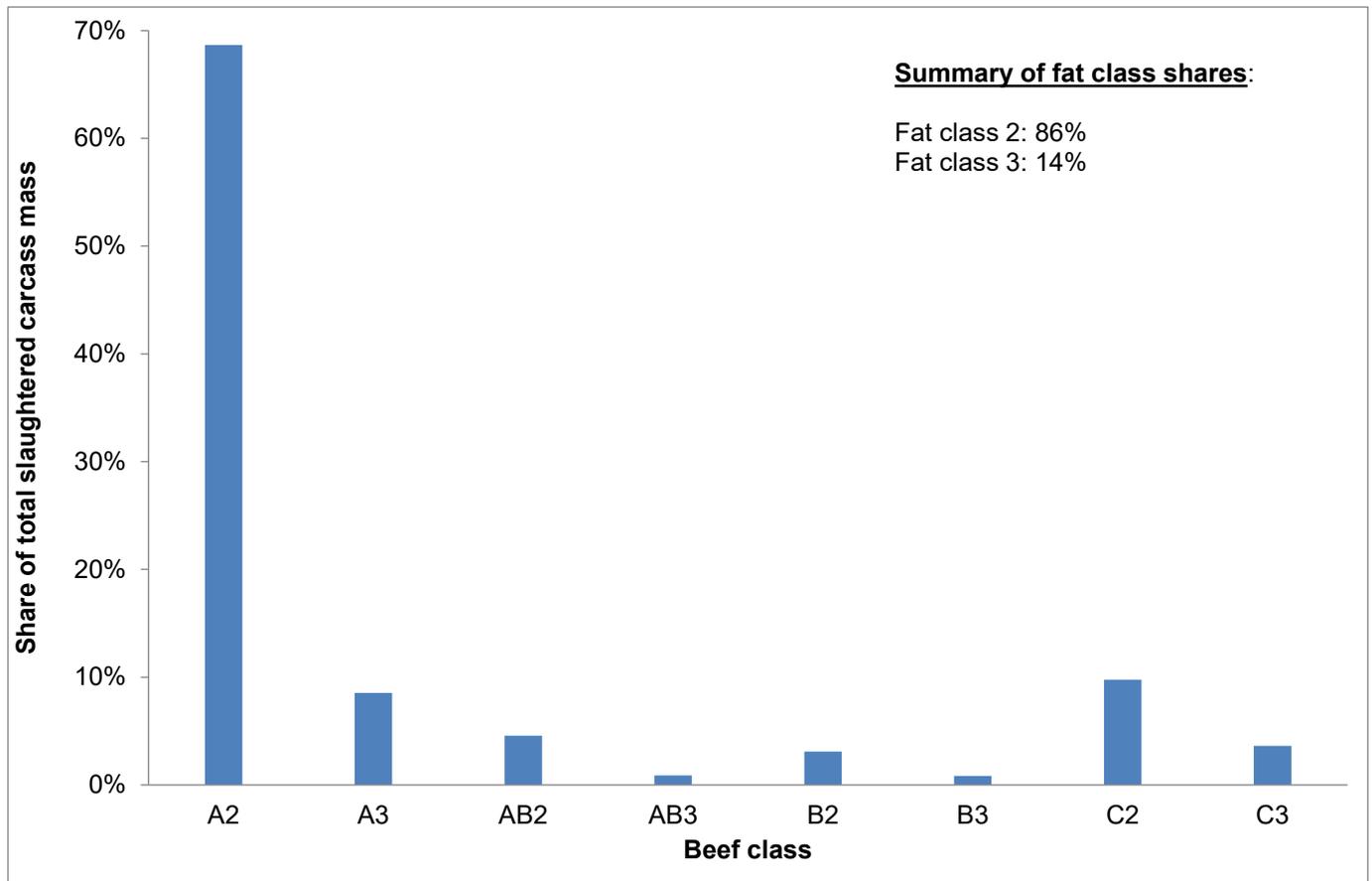


Figure 1: The relative importance of beef classes in 2017 in South Africa (aggregated from weekly data), based on the total carcass weights slaughtered (Source: Own calculations, based on slaughtering statistics for 2017 as published by the RMAA (RPO, 2018))

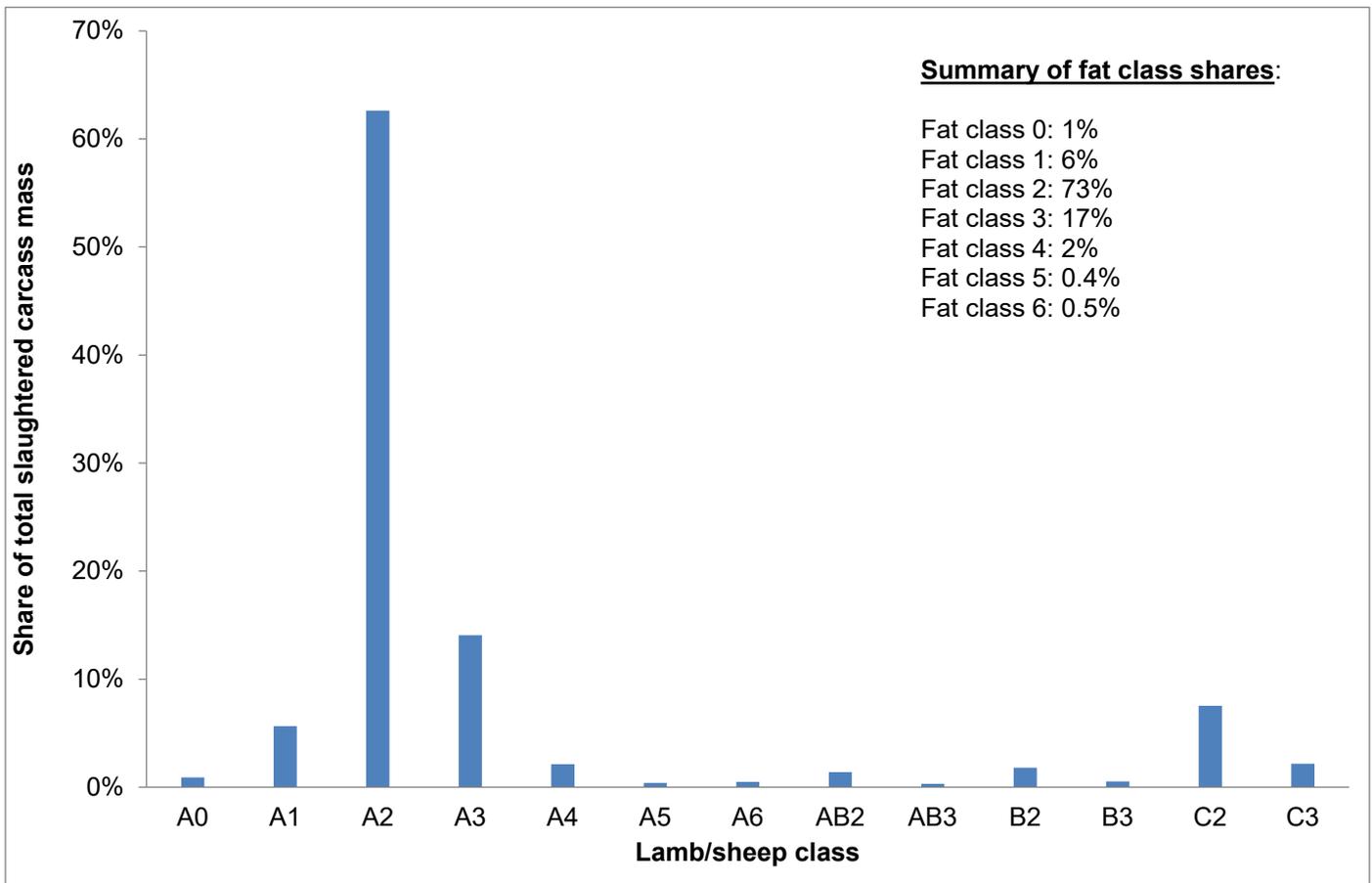


Figure 2: The relative importance of lamb/sheep classes in 2017 in South Africa (aggregated from weekly data), based on the total carcass weights slaughtered (Source: Own calculations, based on slaughtering statistics for 2017 as published by the RMAA (RPO, 2018))

The objective of the research presented in this paper is to present a review of literature on the fat-related preferences of South African consumers, regarding aspects such as visible fat, marbling and fat colour. This literature review study was requested by the RMRD SA Planning Committee Cattle and Small Stock in a communication dated 4 December 2017.

2. Methodology:

A wide range of search engines (e.g. Google Scholar, EBSCO Open Access Business and Economics Collection and Business Source Complete) were utilised to search for relevant literature, applying keywords such as beef, mutton, lamb, red meat, fat and consumer. In Table 1 an overview of the various studies evaluated for this literature review is presented, in terms of focus (geographical, socio-economic, product (species, cuts), when conducted, sample size, sampling approach, survey instrument, how respondent interaction was approached, methodology overview and objective of the particular reviewed study. Furthermore, comparative results are also presented on fat-related aspects from market research conducted for the now disbanded Meat Board (e.g. Meat Board's Quantitative Survey, 1996; Protein survey, 1996; Quantitative survey, 1997; South African Pork Producers Organisation, 2000).

Table 1: Summary of background information regarding the reviewed literature on the fat-related preferences of South African consumers

Reference:	Geo-Graphical and socio-economic focus:	Product focus:	When?	Sample Size:	Sampling:	Survey Instrument:	Respondent Interaction:	Methodology aspects:	Research focus:
Lombard, 2018	Free State Mangaung Municipality Entire socio-economic spectrum	Beef and mutton/lamb	2017	n=350	Convenience sampling by means of a interceptive survey – participants approached as they moved past the eye-tracking station in-stores.	Eye-tracking tests & questionnaire	Face-to-face interaction to complete eye-tracking test and questionnaire afterwards.	A Tobii T120 eye-tracker was used. Respondents were shown various images for 5 seconds each. Product variations were based on: meat colour (bright red, dark red, brownish), fat on cuts (very little, medium and large amounts), marbling (yes or no), packaging, classification, price per kilogram, price per pack, nutritional information, brand, breed of animal, quality indicating labels and origin. Data visualisation involved Gaze plots and heat maps. After the eye-tracking test the questionnaire involved demographics, how household eat red meat, cut preferences, what respondents could recall from the eye-tracking images viewed.	To test marketing attributes according to impulsive purchasing behaviour of consumers on beef products. (Eye tracker); To test marketing attributes according to impulsive purchasing behaviour of consumers on mutton products. (Eye tracker); To make recommendations to industry regarding the packaging and marketing of red meat products
Xazela, Hugo, Marume & Muchenje, 2017	Seven villages in the Eastern Cape – Amathole and Chris Hani Districts Low-income households	Red meat	2017	n=466	Random selection process	Questionnaire	Face-to-face interviews in respondents' homes	Questions focus on: Demographics, meat purchasing decisions, preferred meat products, meat product most consumed at home, ability to evaluate the quality of meat by visual assessment, consumption patterns and health issues. Likert-type scales applied to measure the importance of visual cues and purchasing decisions and agreement levels with meat quality aspects. Analyses involved frequencies, chi-square analyses, principal component analyses, CALIS equation modelling with root mean square error of approximation used as the primary fit measure.	To determine the perceptions of rural low-income consumers on meat quality and health issues associated with meat consumption.
Vermeulen, Schönfeldt & Pretorius, 2017, 2018	Urban consumers across the socio-economic spectrum in Gauteng and the larger Cape Town area	Beef and mutton/lamb	Gauteng study: 2012/ 2013 WC study: 2016/ 2017	Gauteng: n=584 WC: n=750	Quota sample to reflect the demographic profile of consumers in upper-middle and wealthy segments, approached with door-to-door recruitment and screening	Questionnaire	Face-to-face interviews in respondents' homes	Questions focussed on: meat purchasing and consumption behaviour (including factors considered when purchasing red meat); motivations and perceptions towards red meat; used and most trusted information sources on red meat; red meat in the context of food-away-from-home; red meat labelling; red meat classification. Types of questions: open, closed options, Likert-rating scale type questions (e.g. perceived importance / trust / usage).	To investigate South African consumer behaviour towards and perceptions regarding red meat

Table 1 (continued): Summary of background information regarding the reviewed literature on the fat-related preferences of South African consumers

Reference:	Geo-graphical focus:	Product focus:	When?	Sample Size:	Sampling:	Survey Instrument:	Respondent Interaction:	Methodology aspects:	Research focus:
Marandure, Mapiye, Makombe, Nengovhela, Strydom, Muchenje & Dzama, 2016	Five rural town in the Eastern Cape Most respondents were from a low disposable income group	Pasture-fed beef produced by smallholder producers	2015	n=155	Consumers at retail outlets in village (meat purchasers for the household)	Questionnaire	Face-to-face interviews	Questions focused on demographics, most preferred beef market, beef purchase frequency, preferred type of beef, purchase factors, previous experience with branded beef, branded beef preferences, willingness to buy, willingness to pay a premium and potential purchase factors regarding pasture-fed beef brand and information that should be included on the label of pasture-fed beef. Analyses involved descriptive statistics, analysis of variance, binary logit modelling.	Perceptions of consumers on the development of a natural pasture-fed beef brand by smallholder producers in the Eastern Cape.
Maré, Taljaard & Jordaan, 2013	Cape Town Entire socio-economic spectrum	Beef	March 2009	n=471	Random walking method in and around different supermarkets.	Questionnaire	Face-to-face interviews	Types of questions: closed answers, Likert-type scales, ranking questions Research components: <ul style="list-style-type: none"> Demographics Perceived importance via Likert-type scales and ranking Logit regression models run on different preference groups.	Red meat purchase considerations; Consumer preferences for beef fat colour
Rani, Hugo & Muchenje, 2013	Five municipalities in the Eastern Cape: Buffalo City, Nkonkobe, Nxuba, Lukhanje and Amahlathi municipalities targeting urban and rural towns Lower- and middle-income consumers	Mutton	2013	215	Random selection of consumers purchasing mutton from retail outlets in chosen areas.	Questionnaire	Face-to-face interviews	Questions focus on: Demographics, meat purchasing decisions, protein food preferences, preferred meat parts, ability to access the quality of mutton visually, mutton quality perceptions and consumers' health. Analyses involved the construction of frequencies and chi-square tests to investigate associations.	To determine the perceptions of consumers from the Eastern Cape Province of South Africa on the quality of mutton.
Vermeulen & Biénabe, 2010	Gauteng Upper-middle-income and affluent segments	Beef steak	October to December 2009	n=420	Quota sample to reflect the demographic profile of consumers in upper-middle and wealthy segments, approached with door-to-door recruitment and screening	Questionnaire	Face-to-face interviews	Types of questions: closed answers and ranking tasks Research components: <ul style="list-style-type: none"> Demographics Perceived importance via ranking 	Beef steak purchase considerations, within the larger focus of the study (to investigate the fresh food quality evaluations and perceptions of SA upper-middle-income and affluent consumers)

Table 1 (continued): Summary of background information regarding the reviewed literature on the fat-related preferences of South African consumers

Reference:	Geo-graphical focus:	Product focus:	When?	Sample Size:	Sampling:	Survey Instrument:	Respondent Interaction:	Methodology aspects:	Research focus:
Shongwe, Jooste, Hugo, Alemu & Pelser, 2007	Bloemfontein Lower-income consumers purchasing mainly the fore quarter of the beef carcass not included.	Beef T-bone and rump	March & April 2005	Beef cut samples collected at 16 super-markets	Collection of beef samples and prices at 16 geographically separated supermarkets in Bloemfontein	Collection of data on product price and meat/fat composition aspects	N/A	Beef cut prices were recorded. Beef cuts were subjected to the following analyses: weighing, measuring external subcutaneous fat, dissecting of cuts and chemical fat determination.	Do consumers value beef fat according to beef product type and fat location in the cut?
Taljaard, Jooste & Asfaha, 2006	National focus	Meat in general	Time series data from 1970 to 2003	N/A	N/A	N/A	N/A	Applied Ordinary Least Squares (OLS) and the Johanse co-integration approach to a conventional demand function taking the following data into consideration: annual time series data of meat consumption and prices, real per capita income	To develop a broader understanding of SA consumer spending on meat with a specific focus on economic and non-economic influencing factors.
Taljaard, Alemu, Van Schalkwyk, 2003	National focus	Meat in general	Time series data from 1970 to 2000	N/A	N/A	N/A	N/A	Applied a Linear <i>Approximated Almost Ideal Demand System (LA/AIDS)</i> , estimated in first differences to estimate the demand relations for meat (beef, chicken, pork and mutton) in South Africa from 1970 to 2000.	To develop a broader understanding of South African meat demand relationships

3. Results

3.1 The relative importance of fat among red meat purchase considerations:

Table 2 presents an overview of the relative importance of fat-related aspects among consumers' red meat purchase considerations from various literature sources. In general consumers across the socio-economic spectrum have a strong focus on affordability (price), food safety (including sell-by date or expiry date) and visual appeal (e.g. meat colour, neat cuts, no blood, packaging/presentations) when purchasing red meat. The fat content of red meat was not among these strongly dominant factors, but was still among the 'important' purchase factors of all the reviewed studies.

Interesting observations from the information presented in Table 2:

- Comparing the fat-related results of Maré *et al* (2013) and Lombard (2018) it is interesting to note that the average rating scores for the amount of visible fat and visible fat distribution were very similar in the two studies being in the order of a value of 4 on a scale ranging from 1 (not important) to 5 (very important). Even though these high scores indicate that fat amount and distribution were important to consumers, the study by Maré *et al* (2013) did not address the question whether consumers preferred leaner or fatter red meat. The research by Lombard (2018) revealed the following fat preferences: very lean (12.7% of the sample), lean (20.8%), medium (54.7%), fat (7.2%), high fat (4.6%) – thus revealing the dominance of 'medium' fat followed by a 'lean' fatness level.
- Research by Vermeulen *et al* (2018) indicated that:
 - When purchasing red meat certain factors are important across the socio-economic spectrum overlapping in the WC and Gauteng (as could be seen in the more detailed results presented in Table 2):
 - Food safety (including food safety, expiry date, clean meat with no blood, shelf life at home);
 - Appearance (appearance in general, visual appeal, colour of meat, colour of fat)
 - Affordability (price)
 - Organoleptic appeal (taste, flavour, eaten by all in family, tenderness, juiciness)
 - General quality (quality guarantee)
 - Fattiness (fat-to-meat ratio)
 - Convenience (easy to prepare)
 - For consumers in the Western Cape fat colour was relatively more important than fat to meat ratio for all consumers when purchasing beef and for low- and high-income consumers when purchasing mutton/lamb.
 - In general consumers perceived fat to meat ratio and low fat or lean meat as important red meat purchase considerations – suggesting a preference towards leaner red meat cuts.

The Meat Board consumer studies of 1996 and 1997 found that the most important factors considered by consumers when deciding to buy meat were: taste (75% and 73% of total samples in 1996 and 1997), meat colour (48% and 46%), amount of fat (45% and 40%), price (36% and 38%), tenderness (30% and 27%), nutritional value (21% and 17%), fresh not frozen (20% and 18%), packaging (17% and 14%), classification (15% and 15%) and preparation time (14% in both years). Comparing these results to more recent studies suggest that over time price / affordability and fat content has become relatively more important and that sensory- and visual appeal remained important.

Taljaard, Jooste & Asfaha (2006) found that the effects of non-economic factors (such as health, safety, convenience, quality, animal welfare and the environment) are becoming more important than in the past. Even though fat content was not specified as such, it could potentially be included

within the aggregate set of non-economic factors linked to health and quality. The study stressed the importance of the meat industry understanding consumer attitudes and preferences regarding non-economic factors in order to promote red meat demand. The study did not include any specific non-economic factors in their analysis, but treated non-economic factors as an aggregate variable in the model applied.

Taljaard, Alemu and Van Schalkwyk (2003) found that chicken can be classified as a necessity product while beef and mutton can be considered as luxury products (with pork almost being a luxury product). Even though the study did not include any specific non-economic factors, luxury products could potentially involve a stronger consumer focus on non-economic product factors of which fat content might come into consideration. However, no specific fat-related components were evaluated in this particular study.

Evidence from a range of studies presented in this section suggest that fat-related attributes (fat content, low-fat / lean meat and fat colour) has a definite prominent position in the set of factors influencing consumers red meat purchase decisions across the socio-economic spectrum.

Table 2: Overview of the relative importance of fat-related aspects among consumers' red meat purchase considerations from various literature sources

Reference:	Maré <i>et al</i> , 2013	Vermeulen & Biénabe, 2010	Rani <i>et al</i> , 2013	Lombard, 2018	Marandure, <i>et al</i> , 2016																																								
Geographical focus:	Western Cape, Cape Town	Gauteng	Eastern Cape	Free State	Eastern Cape																																								
Socio-economic focus:	Entire socio- economic spectrum	Upper-middle-income and affluent consumers	Lower- and middle-income consumers	Entire socio- economic spectrum	Lower-income consumers																																								
Product focus:	Beef	Beef	Mutton	Beef and mutton/ lamb	Pasture-fed beef produced by smallholder producers																																								
Scale applied:	5-point rating scale (1=not important; ...; 5=very important)	Not applicable	Not applicable	5-point rating scale (1=not important; ...; 5=very important)	Not applicable																																								
Meat purchase factors:	<table border="0"> <tr> <td>Factor:</td> <td>Average score:</td> </tr> <tr> <td>Sell by date</td> <td>4.6</td> </tr> <tr> <td>Price</td> <td>4.4</td> </tr> <tr> <td>Neat packaging</td> <td>4.3</td> </tr> <tr> <td>Neat cuts</td> <td>4.3</td> </tr> <tr> <td>Blood in packaging</td> <td>4.3</td> </tr> <tr> <td>Meat colour</td> <td>4.2</td> </tr> <tr> <td>Fat, fat distribution</td> <td>4.1</td> </tr> <tr> <td>Texture</td> <td>4.0</td> </tr> <tr> <td>Classification</td> <td>3.8</td> </tr> <tr> <td>Thickness of cuts</td> <td>3.8</td> </tr> <tr> <td>Branding</td> <td>3.7</td> </tr> </table>	Factor:	Average score:	Sell by date	4.6	Price	4.4	Neat packaging	4.3	Neat cuts	4.3	Blood in packaging	4.3	Meat colour	4.2	Fat, fat distribution	4.1	Texture	4.0	Classification	3.8	Thickness of cuts	3.8	Branding	3.7	<p>(% in brackets: Share of sample (n=420) listing factors among top three most important purchase factors)</p> <p>Price (98%) Expiry date (91%) Appearance (89%) Quality guarantee (83%) Food safety (65%) Fat content (60%)</p>	<p>(% in brackets: Share of sample (n=420) mentioning particular factor as relevant when purchasing mutton)</p> <p>Price (±65%) Quality (±20%) Health (±15%)</p> <p>With superior mutton quality perceived to be linked to: Taste (±40%) Juiciness (±25%) Fatness (±20%) Tenderness (±10%) Colour (±5%)</p>	<p>(NOTE: This is preliminary results obtained from WA Lombard)</p> <table border="0"> <tr> <td>Factor:</td> <td>Average score:</td> </tr> <tr> <td>Colour of meat</td> <td>4.5</td> </tr> <tr> <td>Neatness of cut</td> <td>4.5</td> </tr> <tr> <td>Visible fat amount</td> <td>4.1</td> </tr> <tr> <td>Bone to meat ratio</td> <td>4.1</td> </tr> <tr> <td>Visible fat distribution</td> <td>3.9</td> </tr> <tr> <td>Blood in packaging</td> <td>3.8</td> </tr> <tr> <td>Classification</td> <td>3.6</td> </tr> </table>	Factor:	Average score:	Colour of meat	4.5	Neatness of cut	4.5	Visible fat amount	4.1	Bone to meat ratio	4.1	Visible fat distribution	3.9	Blood in packaging	3.8	Classification	3.6	<p>(% in brackets: Share of sample (n=155) mentioning particular factor as relevant when purchasing pasture-fed beef)</p> <p>Price (25%) Expiry date (20%) Packaging/presentation (5%) Origin (11%) Fat colour (10%) Nutritional quality (8%) Healthfulness (6%) Lean colour (6%) Ethical quality (1%)</p>
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Table 2 (continued): Overview of the relative importance of fat-related aspects among consumers' red meat purchase considerations from various literature sources

Reference:	Xazela, Hugo, Marume & Muchenje, 2017	Vermeulen, Schönfeldt & Pretorius, 2018		
Geographical focus:	Eastern Cape	Gauteng & Western Cape		
Socio-economic focus:	Low-income consumers	Low-, middle- and high-income consumers		
Product focus:	Red meat	Beef		
Scale applied:	Not applicable	Not applicable		
Meat purchase factors:	<p>Price – dominant extrinsic cue; Colour and fat marbling – dominant intrinsic cues. (Thus, visual cues were important to gauge expected meat quality.)</p> <p>Quality of meat was associated with colour, tenderness, juiciness and leanness.</p>	Factors perceived as 'very important' by 75% or more of the various subgroups when purchasing BEEF: (presented in order of importance)		
		Low-income:	Middle-income:	Affluent:
		WC (n=250) Rand per packet Appearance Meat colour Clean / no blood Packaging size Food safety Expiry date Price/kilogram Taste Flavour Fat colour	WC (n=250) Price Expiry date Juiciness Clean meat, no blood Visual appeal Tenderness Appearance Taste Flavour Meat colour Quality guarantee Food safety Easy to prepare Succulence Convenience Eaten by all Keepability at home Fat colour Preparation time Nutritional value Personal preferences Low fat, lean Intended use Store where bought Fat to meat ratio Store Fresh not frozen	WC (n=250) Taste Price Expiry date Visual appeal Appearance Flavour Clean meat, no blood Tenderness Meat colour Juiciness Food safety Quality guarantee Fat colour Succulence Fresh not frozen Bone to meat ratio Eaten by all Store where bought Easy to prepare Store Keepability at home Low fat, lean Past experience
		Gauteng (n=164) Price Appearance Cleanliness Quality guarantee Colour of meat Convenience Tenderness Expiry date Eaten by all in household Amount of meat / pack Bone-to-meat ratio Fat-to-meat ratio Easy to prepare Packaging size Preparation time Colour of fat Taste Fresh Packaging type Juiciness	Gauteng (n=171) Price Colour of meat Easy to prepare Flavour Clean meat Food safety Taste Expiry date Juiciness Appearance Quality guarantee Eaten by all in family Fat-to-meat ratio Tenderness Visual appeal Store where you buy Packaging size Convenience Fresh meat Preparation time Brand / reputation Low fat, lean Personal preferences Succulence Keepability at home Past experience	Gauteng (n=249) Taste Expiry date Price Colour of meat Food Safety Flavour Juiciness Clean meat Appearance Tenderness Visual appeal Quality guarantee Eaten by all in family Easy to prepare Amount of fat Store where you buy Succulence Keepability at home Personal preferences Fresh meat Convenience Nutritional value Low fat / lean meat

Table 2 (continued): Overview of the relative importance of fat-related aspects among consumers' red meat purchase considerations from various literature sources

Reference:	Vermeulen, Schönfeldt & Pretorius, 2018		
Geographical focus:	Gauteng & Western Cape		
Socio-economic focus:	Low-, middle- and high-income consumers		
Product focus:	Mutton/lamb		
Scale applied:	Not applicable		
Meat purchase factors:	<i>Factors perceived as 'very important' by 60% or more of the various subgroups when purchasing MUTTON/LAMB: (presented in order of importance)</i>		
	Low-income:	Middle-income:	Affluent:
	W Cape (n=250) Appearance Rand per packet Clean, no blood Meat colour Packaging size Taste Expiry date Price per kg Food safety Flavour Juiciness Amount of fat Fat colour Natural Household preferences Eaten by all Tender	W Cape (n=250) Expiry date Price Taste Juiciness Clean meat, no blood Meat colour Food safety Flavour Quality guarantee Visual appeal Appearance Tenderness Eaten by all Succulence Convenience Easy to prepare Keepability at home Preparation time Nutritional value Personal preferences Intended use Fat to meat ratio Bone to meat ratio Low fat, lean Store where bought Brand/Product reputation Fat colour Fresh not frozen Packaging size	W Cape (n=250) Expiry date Taste Clean meat, no blood Price Appearance Visual appeal Flavour Meat colour Quality guarantee Food safety Juiciness Tenderness Fat colour Fresh not frozen Amount of fat Eaten by all Store Nutritional value Succulence Low fat, lean Personal preferences Convenience Keepability at home Easy to prepare Fat to meat ratio Past purchase experience Hormone free Packaging size Bone to meat ratio
	Gauteng (n=164) Price Appearance Cleanliness Colour of meat Tenderness Quality guarantee Bone-to-meat ratio Expiry date Convenience Amount of meat per pack Fat-to-meat ratio Eaten by all in family Colour of fat Easy to prepare Packaging size Fresh Juiciness Preparation time Taste Packaging type Flavour	Gauteng (n=171) Appearance Food safety Flavour Price Quality guarantee Taste Meat colour Juicy Store where bought Easy to prepare Expiry date Amount of fat Tenderness Convenience Low fat / Lean meat Fresh Eaten by all Package size Preparation time Visual appeal Brand / product reputation Shelf life at home Packaging type Personal preference Clean meat Fat-to-meat ratio	Gauteng (n=249) Expiry date Appearance Taste Colour of meat Price Flavour Food Safety Clean meat Tenderness Quality Guarantee Juiciness Colour of fat Amount of fat Eaten by all in family Nutritional value Keepability Succulence Easy to prepare Personal preferences Store Fat-to-meat ratio Fresh Meat Low fat / lean meat Convenience Past experience Intended use of meat Natural Packaging size Bone-to-meat ratio No additives Preparation time

3.2 Fat within the context of consumers concerns regarding red meat

Table 3 presents a summary of the major red meat concerns among Gauteng and Western Cape consumers according to Vermeulen *et al* (2018), revealing the dominance of price / affordability concerns and health concerns across the socio-economic spectrum in both province. Specific examples of health concerns involved cholesterol, heart disease, high blood pressure, gout and diabetes.

Among low-income consumers in the Eastern Cape, Rani *et al* (2013) also found that consumers' mutton concerns focused on price and fatness. Consumers expressed a specific need for reduced fat in sheep meat linked to health concerns. Xazela *et al* (2017) indicated that the concept of nutritional balance was familiar to 64% of low-income consumers in the Eastern Cape, while 59% were aware of the health risks associated with meat consumption. In this study consumers' also revealed a preference towards boiling meat, in order to avoid adding more fat to meat during the cooking process.

In the context of red meat problems / concerns the Meat Board consumer study of 1996 found that the shares of consumers perceiving meat as:

- 'Expensive': 82% for beef, 93% for lamb and 82% for pork;
- 'High in fat content': 29% for beef, 24% for lamb and 54% for pork;
- 'High in cholesterol': 89% for beef, 95% for lamb and 91% for pork.

The results presented in this section suggest that over time consumers' red meat concerns have remained focussed on affordability, high fat content and health issues.

Table 3: The dominant red meat concerns among Gauteng and Western Cape consumers according to Vermeulen *et al* (2018)

	Gauteng (n=164)	Gauteng (n=171)	Gauteng (n=249)
BEEF	<p>Gauteng (n=164): Affordability (40.2%) Health concerns (45.4%) Long cooking time (2.1%)</p> <p>Western Cape (n=250): Price, affordability (11.2%) Fatty (8.8%) Health: Causes illness in general (5.2%) Takes long to cook (4.8%)</p>	<p>Gauteng (n=171): Price / expensive (17.5%) General health concerns (10.6%) Fatty (5.8%) Takes long to cook (4.7%)</p> <p>Western Cape (n=250): Price, affordability (56.6%) Takes long to cook (30.2%) General quality improvement (24.9%) Fatty (21.5%) Health: cholesterol (20.4%) Not tender (18.6%) Not healthy in general (16.4%) Health: diabetes (15.7%) Health: blood pressure (11.3%) Health: gout (9.1%) Not fresh (6.7%)</p>	<p>Gauteng (n=249): Affordability (35.7%) Fatty (28.5%) Not tender (13.7%) A general quality concerns (no specifics given) (9.6%) Freshness (7.6%) Long cooking time (5.2%) Health concerns (2.4%)</p> <p>Western Cape (n=250): Price, affordability (9.9%) Not healthy in general (35.7%) Takes long to cook (16.3%) Fatty (16.0%) Quality improved (15.6%) Not fresh (15.1%) Not tender (12.8%) Availability (10.0%) Health: cholesterol (8.6%) Availability of right cuts (7.5%) Health: diabetes (6.2%) Animal diseases (5.8%) Health: gout (5.6%) Animal welfare (5.4%) Health: high blood pressure (5.4%) Misleading grading (5.0%)</p>
MUTTON/LAMB	<p>Gauteng (n=164): Affordability (40.2%) Health concerns (45.4%) Long cooking time (2.1%) Limited shelf life at home / no cold storage at home (1.0%) Mixed with strange meat (1.0%) A general quality concerns (no specifics given) (1.0%) Availability (1.0%)</p> <p>Western Cape (n=250): Price, affordability (17.2%) Fatty (11.2%) Health: Causes illness in general (10.4%) Expiry date, freshness (2.0%) Smell bad (1.2%) Health: Causes gout (0.4%)</p>	<p>Gauteng (n=171): Price / Expensive (24.0%) Fatty (11.7%) Health concerns (1.2%)</p> <p>Western Cape (n=250): Price, affordability (40.8%) Fatty (17.2%) Make me sick (10.0%) A general quality concerns (no specifics given) (6.4%) Health - high cholesterol (4.0%) Tough (4.0%) Long cooking time (3.2%) Health- gout (2.8%) Health - diabetes (2.4%) Health - high blood pressure (2.4%)</p>	<p>Gauteng (n=164): Affordability (55.2%) Fatty (37.1%) Bad taste (6.0%) A general quality concerns (no specifics given) (5.6%) Colour (5.2%) Health concerns (4.0%)</p> <p>Western Cape (n=250): Price, affordability (18.0%) Fatty (10.0%) Make me sick (9.6%) A general quality concerns (no specifics given) (4.8%) Not fresh (4.4%) Not tasty (3.2%) Health - high cholesterol (2.8%)</p>

3.3 Consumer preferences pertaining to fat colour

Among a socio-economically diverse sample of consumers in Cape Town, Maré *et al* (2013) identified three consumer segments based on consumers fat colour preferences: 44.4% preferred white fat, 13.8% preferred yellow fat, 41.8% had no particular fat colour preference. Possible reasons presented for the high share preferring white fat were inadequate knowledge on the origin and properties of yellow fat and the possibility that consumers are used to white fat on beef given the dominance of meat from feedlots in the local market. The segment with no particular fat colour preference represented a significant share of the total sample (41.8%) and the authors argued that this group might be persuaded to buy yellow-fat beef through successful marketing. Consumers who preferred yellow fat generally had higher education levels and higher grocery spending and meat spending, were more particular about product freshness and prepared most of their meals at home. Higher education levels could imply that consumers could be more likely to know and understand the origin, properties and benefits of yellow fat and apply these aspects when making red meat purchasing decisions. Consumers who preferred white fat were generally less educated, less discerning about physical meat properties and older.

Marandure *et al* (2016) focused on lower-income consumers in the Eastern Cape to determine consumers' perceptions regarding natural pasture-fed beef produced by smallholder cattle producers (thus linked to the 'yellow fat' product characteristic). More than 80% of consumers were willing to buy natural pasture-fed beef, but a similar share was not willing to pay a premium for the natural pasture-fed beef brand (mainly due to household-level budget constraints). Young consumers and smaller households were generally more willing to pay a premium for a natural pasture-fed beef brand. Consumers' reaction to yellow fat was not mentioned explicitly in the article.

Vermeulen *et al* (2018) found that the share of consumers perceiving fat colour as 'very important' when purchasing beef increased with rising income levels (67.2% of low-income consumers, 71.9% of middle-income consumers and 80.0% of affluent consumers within the combined sample in the two provinces). Given the high shares of consumers perceiving 'fat colour' as 'very important' it is clear that fat colour is an important attribute to beef consumers. The study did not investigate specific preferences for white or yellow fat. However, some respondents did reveal associations between yellow fat colour and meat that is old or not fresh in some of the open-ended questions. In the Western Cape survey consumers perceptions regarding grass-fed or grain-fed beef was tested among middle-income and affluent consumers, with the attribute 'grass-fed' being 'very important' to 46.8% of middle-income and 54.0% of affluent consumers, while the attribute 'grain-fed' was 'very important' to a lower share of consumers (41.2% of middle-income and 46.8% of high-income consumers) – serving as a 'proxy' for the perceived importance of these factors among consumers. Thus, even though 70% to 80% of middle-income and affluent consumers perceive fat colour as 'very important' the lower sample shares perceiving grass-fed or grain-fed beef as 'very important' indicates a disconnect in consumers' minds pertaining to the link between fat colour and animal feeding practices.

There is a need to further investigate consumers' preferences and perceptions regarding beef fat colour among a wide geographical audience in South Africa and also to test the potential impact of improved consumer education on consumers' choices. Consumer education could involve the elimination of misconceptions and present consumers with balanced information on fat colour and associated production systems and nutritional implications. There is also a need to investigate consumers' willingness to pay for beef with white or yellow fat.

3.4 Consumers' preferences for different types and/or quantity of fat on red meat

- Among low- and middle-income consumers in the Eastern Cape, Rani *et al* (2013) found that lean meat were generally more expensive and not affordable by lower-income consumers. Furthermore lean meat was preferred by older consumers linked to the higher incidence of lifestyle diseases among older adult age groups.
- Shongwe *et al* (2007) investigated the link between beef prices and physical presence of different types of fat. The methodology involved the purchasing of beef steak samples at 16 supermarkets in Bloemfontein, after which the samples were weighed, subcutaneous fat

measured and samples were subjected to chemical fat determinations. In contrast to expectations, consumers were willing to pay a premium for additional external fat (a 1% increase in external fat thickness increased the average beef price by 0.045%) – suggesting that consumers liked the current external fat levels presented in retailers. The results were linked to the food culture in Bloemfontein and the traditional cooking style of braai being popular. A 1% increase in seam fat was associated with a 0.025% decrease in product price indicating that seam fat is perceived as a negative characteristic. Even though the cost implications of removing seam fat should be considered, the researchers argued that the removal of seam fat could potentially result in increased demand.

Marbling fat was not associated with the prices of the considered beef cuts, implying that consumers in Bloemfontein did not take marbling fat into consideration when purchasing the particular cuts. The researchers argued that as ‘cattle in South Africa are slaughtered at a relatively young age before marbling could develop to a significant degree, and hence consumers are not accustomed to marbling’.

In contrast to some international literature indicating that external fat and seam fat are undesired product characteristics, Bloemfontein consumers only discriminated against seam fat – illustrating the importance of investigating South African consumers’ meat perceptions and behaviour rather than assuming similar behaviour to what is seen internationally.

- Preliminary results from Lombard (2018) indicates that consumers in the Free State indicated the following stated preferences for the level of fat in meat: medium fat - 54.7%, lean - 20.8%, very lean - 12.7%, fat - 7.2%, high fat - 4.6%. Thus consumers expressed a dominant preference for medium-fat towards lean red meat cuts. More in-depth preliminary eye-tracking results from this study is included later in this section.
- Vermeulen *et al* (2017) found that the share of consumers who were concerned about the fat content of red meat were the most significant for low-income and affluent consumers (67% and 69% respectively) and somewhat lower (58%) for middle-income consumers. ‘Fat concerned’ consumers revealed a higher preference for chicken and a higher tendency to shift some intake of red meat towards alternative animal protein foods options (such as chicken and fish).
- In Gauteng (Vermeulen *et al*, 2017) the share of consumers who perceived beef as generally healthy (i.e. not only health in the context of fat content or other health issues such as cancer risk) were 48% of low-income consumers, 25% of middle-income consumers and 31% of affluent consumers – suggesting a decline in beef health perceptions as income levels increase. The share of consumers who perceived mutton/lamb as healthy were significantly less: 15% of low-income consumers, 16% of middle-income consumers and 19% of affluent consumers.

- ***Preliminary results on the recent ‘eye tracking’ research by Lombard (2018):***

The project is still in the stage of data analysis and reporting, but the researcher provided some preliminary results to be included in this particular literature review.

In terms of the wide range of meat aspects tested, the aspect that received attention from the largest share of consumers (86%) was the fat on the meat. The low average time to first fixation score (0.8885 seconds) suggest that the fat on the meat was the meat aspect that on average received attention first from the participants and fixated on the longest by indication of the average total fixation duration time (1.0612 seconds).

Test involving two beef steak images placed next to each other:

- The beef steak on the left: more fat, vacuumed packed on a polystyrene plate;
- The beef steak on the right: less fat, only vacuumed packed.
- The packaging of the two options differed as packaging type was included as a variable in the experimental design.
- The steak on the right received slightly more attention than the steak on the left. Time to first fixation results suggest that on average consumers were more likely to fixate their attention on the high-fat pack first (0.4792 seconds - average time to first fixation) before moving their attention to the low-fat pack (0.7232 seconds).
- Consumers spent on average 1.7041 seconds fixating on the pack of meat on the left and 1.4259 seconds fixating on the pack the the right. *However, a question arises*

whether these results are linked purely to the product attributes or also partly to the convention of reading from left to right.

- Measurements of the different meat aspects:
 - 86% of the consumers fixated on the meat (meat only, fat excluded) on both of the cuts. The high fat cut received slightly longer average total fixation duration (0.9906 seconds) than the low-fat cut (0.9473 seconds).
 - Fat on the high fat steak received fixations from a smaller share of consumers (57%) than on the low-fat steak (63%). It can be noted that despite the fat on the high fat cut received fixations from a smaller share of participant the fat on the high fat cut was fixated on (0.4916 sec.- average total fixation duration) for longer than the fat on the low-fat cut (0.4211 sec.)

Test involving two beef sausage images placed next to each other:

- The beef sausage on the left: more fat (high fat), vacuumed packed;
- The beef sausage on the right: lower fat, vacuumed packed.
- The share of consumers that fixated on the two packs of sausage was relative similar (88% - high fat vs. 89% - low fat). The average time to first fixation proved to be similar (0.6937 seconds vs. 0.6438 seconds) with the low-fat sausage receiving attention slightly earlier.
- Average total fixation duration for the low-fat sausage was longer (1.7092 seconds vs. 1.5663 seconds) and also received more fixations on average per customer (8.2022 vs. 7.8303 seconds).
- The average time to first fixation results for the labelling aspects suggest that all labelling aspects on the low-fat sausage, except for classification, caught consumer's attention at an earlier stage than the labelling equivalents on the high-fat sausage. With the exception of two aspects (Butcher name and sell by date) the percentage of consumers fixating on the labelling aspect of the low fat-fat sausage was higher. These create the impression that the high-fat sausage does not attract consumers attention to it or its labelling, but rather causes consumers to be more focused on the labelling of the low-fat sausage. The fat in the high-fat sausage was fixated on by on average after 2.4237 seconds by 17% of the consumers for an average fixation duration of 0.3290 seconds. On this image, the fat in the packaging (or in the product) seemed less important to consumers as compared to the alternative, where respectively 57% and 63% of the consumers fixated on the fat on the cut of beef at an earlier stage of the test and for a longer period. Part of the explanation could be that since consumers expect to see fat in the beef sausage they would usually not pay a lot of attention to fat. However, as a high-fat and lower-fat sausage is presented in one view, they do engage in more attention to fat in the sausage.

Test involving sheep meat:

Sheep meat (mutton/lamb) was tested in the eye-tracking test. The image showed three packs of mutton that represented the following three options: medium fat meat, high fat meat and lower fat-highly marbled meat. Results for the medium fat meat, high fat meat and lower fat-highly marbled meat from the test show that a relative high percentage of the consumers fixated their attention on all three of the packs, 82%, 90% and 89% respectively. The high fat meat scored the highest fixation percentage at 90%, with the lowest time to first fixation (0.3774 sec.) and the longest average total fixation duration (1.4071 sec.). The average fixation count was the highest for the high fat meat (7.1841). Results for the other two packs show that highly marbled meat was fixated on average earlier (1.2523 sec. vs 1.3075 sec.) and fixated on more times (5.4066 vs. 4.0830) and for longer (1.0910 sec. vs. 0.8143 sec.) than the medium fat meat.

The 'eye tracking' methodology presents an interesting option to validate consumers' stated preferences (with their actual visual behaviour).

4. Research gaps identified & recommendations for future research

This literature review has underlined the complexity of consumers' thoughts, perceptions and behaviour pertaining to fat and red meat. Even though the reviewed studies have addressed numerous aspects of consumers' preferences and behaviour pertaining to fat in red meat, some critical research gaps were identified

- **Research scope – geographical, socio-economic and cultural:**
Research studies should ideally be conducted within a wide geographical scope and take into consideration different socio-economic sub-groups, different ethnic groups, gender- and age groups. However, often due to limited funding research scopes have to be narrowed down and in the process the wider applicability of the results is undermined.
- **Specific species and cuts:**
Research should ideally involve specific red meat species and cuts.
- **Research approaches:**
In order to develop a comprehensive understanding of South African consumers' perceptions and behaviour regarding the fat in red meat a combination of multiple research approaches will have to be utilised, for example questionnaire-based research, visual aids (photos'), experimental economics designs and novel techniques such as eye-tracking. Furthermore, qualitative approaches such as focus groups would probably have to be employed to develop a deeper understanding of the reasoning behind consumers' choices and behaviour.
- **A dynamic perspective:**
Future research could have some focus on the dynamic nature of consumers' behaviour and perceptions regarding fat on red meat – to gauge changes over time and the reasons behind these changes.
- **Lean or not?**
It is important to evaluate the importance attached to fat in red meat or fat-to-meat ratio and then move on to the next level where the investigation should focus on whether consumers prefer red meat with more fat or leaner red meat and the reasoning behind these choices.
- **Linking fat in red meat with health:**
Future research should investigate consumers' reasoning, preferences, perceptions and behaviour for fat in red meat from the point of view of health considerations.
- **Linking fat in red meat with eating occasions:**
Future research should investigate consumers' reasoning, preferences, perceptions and behaviour for fat in red meat from the point of view of different eating occasions (e.g. weekday meals, weekend meals, when having a braai, when entertaining).
- **Linking fat in red meat with eating quality expectations:**
Future research should investigate consumers' reasoning, preferences, perceptions and behaviour for fat in red meat from the point of view of eating quality expectations (e.g. taste, tenderness, juiciness). Furthermore it is critical to investigate consumers' trade-offs, for example potentially accepting a bit more fat in red meat if it ensures a more tasty and tender final product, or accepting a very lean red meat cut due to health considerations despite some loss in eating quality.
- **Linking fat in red meat with affordability / value-for-money expectations:**
Future research should investigate consumers' reasoning, preferences, perceptions and behaviour for fat in red meat from the point of view of expectations pertaining to affordability and value-for-money.
- **Understanding red meat fat colour preferences:**
In the light of the subjective nature of colour in the minds of consumers, it is not adequate to simply ask consumers to state their preference for white or yellow fat from memory. Consumers should rather be presented visual aids illustrating red meat cuts with different shades of white or yellow fat. Other factors that should be taken into consideration in these experimental designs include the effect of age, product handling and packaging type on fat colour. In addition to measuring consumers' red meat fat colour preferences, it is also critical to investigate consumers' knowledge and perceptions behind their revealed preferences, with

preferences for fat colour linked to aspects such as health perceptions, freshness perceptions and grass-fed or grain-fed meat.

- ***Investigating marbling preferences:***

Very little has been done to investigate the preferences of South African consumers pertaining to fat marbling. Future consumer research should be based on photos or actual cuts with variations in marbling.

- ***Dealing with potentially overlapping terminology pertaining to fat and red meat:***

Some of the reviewed studies included factors such as 'fat-to-meat ratio' and 'low-fat' meat in the numerous factors evaluated by consumer when making red meat purchasing decisions. As 'low-fat' could be embedded in 'fat-to-meat ratio' among consumers with a preference for leaner red meat options, another potential option could be that 'fat-to-meat ratio' is important to a consumer even though the consumer prefer red meat with more fat due to a particular reason. However, there is a lack of evidence in this regard which should be addressed by future research. Furthermore it is important to ensure that terminology presented to consumers in survey instruments are developed by a combined consultation of literature and consumers' views.

- ***Investigating the factors considered by consumers when purchasing red meat:***

In most consumer studies investigating the range of factors considered by consumers when purchasing red meat, consumers were presented with a combination of attributes that could be evaluated before purchase (e.g. price, meat colour, fat colour, visible fat, packaging, meat cut, etc) and 'experience' attributes that can only be evaluated by the consumers after the product has been consumed (e.g. taste, tenderness, juiciness). Future studies investigating consumers' red meat perceptions and behaviour could be designed with a clear distinction between attributes that could be evaluated before purchase and experience attributes.

A general recommendation to improve the quality and relevance of consumer research among South African red meat consumers is to include broad-based consultation across various disciplines in the study design process (e.g. statistical experts, consumer science, meat science and animal science).

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