ORGAN-MEAT FUNCTIONALITY AND DIGESTIBILITY

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I. INTRODUCTION

Organ meat (OM), otherwise known as offal or carcass fifth quarter meat is hardly consumed by the average western consumer for many reasons. Among these are food safety concerns and the image of OM as a low class food fit for the poor and in the society. However, in non-western countries, OM is considered a delicacy that consumers pay a premium for compared to the meat from the other quarters of the carcass. OMs may also be rich in functional peptides and nutrients that are more readily available when digested in the gastrointestinal tract and their proteins may have other processing functionalities in soft and semi-solid gel type products compared to their equivalents from muscle/meat. This study hypothesised that OM are as functional and digestible as meat, and the hypothesis was tested by comparing the composition, relevant soft gels processing functionalities and digestibility of bovine OM with *M. semitendinosus* from the same animals from which the OMs were sourced.

II. MATERIALS AND METHODS

Organ meats (OM) including heart, kidney, spleen and liver, and meat (eye of the round muscle, *M. semitendinosus*) from five steers (~ 30 month old) were collected from a local abattoir and transported to the laboratory chilled for further processing and analysis. The moisture, protein and fat content of the samples were determined using AOAC Methods by a commercial analytical service provider. Emulsion Activity Index (EAI) and Emulsion Stability Index (ESI) of the extracted proteins were measured as described in [2]. Protein gelation and the resulting gel texture analysis (Gel stress and deformation) using the Vane Method according to [3]. Offal and meat digestibility was assessed on protein basis using an *in vitro* model as described in [4]. Data was analysed using ANOVA and the means were separated ($P < 0.05$) using the LSD function in R.

III. RESULTS AND DISCUSSION

Beef OM except liver had higher moisture and fat compared to meat from the same animal (Table 1). Liver had the least moisture and fat compared to the other OM ($P < 0.05$). The ability of extracted proteins from OM and meat to emulsify fat (EAI) and the stability of the emulsified fat over time (ESI) are shown in Table 1. Liver proteins had the highest EAI compared to the other meats ($P < 0.05$), with no difference in the stability of the emulsions ($P > 0.05$). The gel strength (GS) and deformability (GD) of the gels formed from the extracted proteins were similar except that of liver, which was significantly lower than the others ($P < 0.05$). The higher EAI and the lower GS of liver proteins suggest these proteins are smaller in size and suited more for softer and fluffier gels compared to proteins from the other meat sources. The lower molecular weight and globular nature of the liver proteins could also be the reason for the higher *in vitro* digestibility of liver compared to the other meats (Table 1). The digestibility of liver and kidney were significantly higher than that of meat and the other OMs in the first hour of incubation. This makes OMs versatile ingredients for incorporating into various formulations where quick digestibility is of high relevance. The differences in the composition and functionality between OM and meat present opportunities for incorporating OM in dishes and ready-meals, as well as in further processed products where soft gel textures are desirable attributes. The use of OM will also increase the value of the whole carcass and would address the issues posed by the rising tide of flexitarianism – a dietary lifestyle which encourages whole animal utilization and reduction in food waste. Due to the soft texture of liver and kidney and their corresponding high functionality, these OM could be valuable resource for the 1st and 3rd age consumer demographic groups that struggle with the chewing and swallowing of flesh meat due to its texture [5].

Table 1. Composition, functional attributes and digestibility of bovine organ-meat and muscle-meat							
Attributes	Organ-meats (OM)				Eye of Round	SED	*P*- value
	Heart	Kidney	Spleen	Liver			
Moisture %	72.06^{ab}	74.74^{a}	74.01^{a}	68.97^{b}	71.60^{ab}	1.98	0.002
Fat %	9.97^{a}	7.47^{a}	6.76^{ab}	2.25^{b}	6.13^{ab}	2.34	0.001
Protein %	18.43^{ab}	16.47^{a}	17.33^{a}	20.27^{bc}	22.73^{c}	1.21	0.001
EAI (m^2/g)	41.79^{a}	41.29^{a}	41.85^{a}	61.75^{b}	38.74^{a}	2.88	0.001
ESI (min)	38.27	36.56	38.45	38.17	36.72	2.52	0.93
GS (kPa)	5.28^{ab}	7.70^{a}	3.14^{bc}	1.07^{c}	5.19^{ab}	1.46	0.005
GD (rad)	0.80^{ac}	0.88^{ab}	0.79^{ac}	0.62^{c}	0.65^{c}	0.10	0.04
RD @ 5 min	54.68^{a}	73.90^{b}	45.01^{a}	84.06^{b}	56.34^{a}	6.11	0.001
RD @ 1h	79.86^{ab}	82.53^{ab}	75.55^{a}	86.43^{b}	75.84^{ab}	5.30	0.05
RD @ 4h	95.33^{ab}	91.98^{a}	94.50^{ab}	96.32^{b}	95.09^{ab}	3.10	0.006

EAI = Emulsion activity index; ESI = Emulsion stability index; GS = Gel Strength; GD = Gel Deformation; RD = Relative digestibility; SED = Standard Error of Difference; Means in the same row bearing the same superscripts are not different ($P > 0.05$).

IV. CONCLUSION

Outcomes of this study confirmed our hypothesis that beef organ meats are as functional and digestible as their equivalents in meat. The implication of the outcome of the current study is that organ meats may offer an opportunity to formulate more digestible animal protein food products for consumers, such as infants with less developed GI or for older consumers with compromised tracts due to GI related ailments or their counterparts in companion animals. Products such as soft-gelled custards, mousses and infant weaning foods and ready-to-eat or ready-to-heat meals could be produced using liver and kidney as a way of value-adding to these ingredients.

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