

# LIVER-BASED INFANT COMPLIMENTARY FOOD

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## I. INTRODUCTION

The unavailability of required macro and micronutrients during weaning period affects the intellectual and physical growth of infants and toddlers. Recent estimations show that nearly one-third of child deaths could be prevented by a combination of exclusive breastfeeding for 6 months, optimal complementary feeding practices, and zinc and vitamin A supplementation [1]. Meat and liver are concentrated nutrient sources relevant for the psychomotor development of babies [2] due to their bioavailable and easy absorbable iron and zinc [1]. Beef liver is also a good dietary source of choline, essential for normal function of all cells [3], and is rich in essential fatty acids important for neuro- and cognitive development in last trimester of pregnancy and first two years after birth. The aim of the present study is to determine if liver can be successfully incorporated into the formulation of an infant complementary food due to its high nutritional functionality.

## II. MATERIALS AND METHODS

Three different baby food formulations were prepared: T1 (beef liver 20%, pumpkin 40%, and carrot 40%), T2 (beef meat 15%, pumpkin 40%, and carrot 45%), and T3 (50% pumpkin and 50% carrot). Beef liver, meat, carrot and pumpkin were washed, cut into pieces and cooked at 105 °C for 15 minutes. All ingredients were cooked separately to avoid possible enzymatic reactions between ingredients before mixing, and were bowl chopped for four minutes separately. Resulting infant food treatments were packaged and stored at -5 °C for further analysis. Proximate analysis were conducted according to AOAC methods [4]. Moisture content via oven drying, crude protein via Kjeldhal method and crude fibre via acid and alkali digestion. Crude fat estimated by Soxhlet extraction, ash content determined by the muffle furnace method and nitrogen-free extract content of the each treatments were compared. Colour, pH, and water activity were measured as described in [5]. 81 consumer panellists made up of parents of 5 to 6 month old children tasted the products for acceptability. The panellists were asked to record their observation on a 1-10 anchored scale (1 and 10 points, strongly dislike and strongly like respectively). Data analysis was carried out using ANOVA using R<sup>®</sup> (2003) statistical software in pairwise comparison of least significant difference at P<0.05.

## III. RESULTS AND DISCUSSION

The nutritional composition of food plays an important role in the overall acceptability of a food for a growing infant. The formulation containing beef liver (T1) was found to have the highest concentration of protein, fat and minerals (Table 1). Due to its relatively low carbohydrate content, the crude fibre content of the liver-formulation was lower than that of the vegetable-based formulation (T3), and on a dry basis was found to be lower than the formulation containing beef muscle (T2).

Table 1: Mean nutrient content, moisture content (g per g wet weight) water activity, pH, and colour for each formulation obtained for five replicate samples.

Treatment	Composition						a <sub>w</sub> and pH		Colour Space			
	Energy (kcal)	Protein (g)	Fat (g)	Fibre (g)	Ash (g)	Carbohydrate (g)	Moisture (g)	a <sub>w</sub>	pH	L*	C*	H
T1	57.87 <sup>a</sup>	7.38 <sup>a</sup>	1.81 <sup>a</sup>	3.81 <sup>a</sup>	0.88 <sup>a</sup>	3.01 <sup>a</sup>	83.11 <sup>a</sup>	0.99 <sup>a</sup>	6.11 <sup>a</sup>	57.88 <sup>a</sup>	42.05 <sup>a</sup>	79.78 <sup>a</sup>
T2	42.90 <sup>b</sup>	6.34 <sup>b</sup>	0.50 <sup>b</sup>	3.71 <sup>b</sup>	0.79 <sup>b</sup>	3.26 <sup>a</sup>	85.40 <sup>b</sup>	0.99 <sup>a</sup>	5.78 <sup>b</sup>	56.09 <sup>a</sup>	43.36 <sup>a</sup>	77.75 <sup>a</sup>
T3	27.66 <sup>c</sup>	1.60 <sup>c</sup>	0.21 <sup>b</sup>	4.24 <sup>c</sup>	0.75 <sup>c</sup>	4.84 <sup>b</sup>	88.36 <sup>c</sup>	0.99 <sup>a</sup>	5.79 <sup>b</sup>	58.08 <sup>a</sup>	52.15 <sup>b</sup>	73.98 <sup>a</sup>

\*Values followed by the same letters in each column are not significantly different (P>0.05)

Moisture content, water activity ( $a_w$ ) and pH directly impact the shelf life and stability of a food product, with high moisture content and water activity providing optimal conditions for microbial proliferation [6]. All three formulations contained high moisture content, ranging from 83 – 88 wt%, and consequently high water activity at 0.99. Although high moisture content dilutes the nutrient composition of the formulation, it may lower the viscosity and potential strong flavours.

Suitable pH ranges from 5 to 6 for baby food formulations, and the formulation which included liver (T1) was found to have a pH of 6.11. This may require buffering in future product investigations through the use of ascorbate, which may provide an additional measure of colour stability due to its antioxidant properties. Colour plays an important role in the appearance, consumer preference and overall acceptability of a product. The colour of a product depends largely on the ingredients used and what processing techniques have been employed. Both carrot and pumpkin contain high concentrations of carotenoids which contribute to the yellow colour of the product, particularly in formulation T3. The addition of liver (T1) and meat (T2) results in a product duller in colour, indicated by the decreased chroma value “C\*” compared to T3. No significant variation in the lightness ( $L^*$ ) and hue (H) profiles between the treatments was observed. The colour properties of the vegetable-based formulation (T3) were also found to be most preferable among consumers (Table 2) compared with T1 and T2. The formulation which included liver (T1) was found to have slightly higher overall acceptability, due to its preferable flavour, texture and aftertaste. However, these differences were not found to be statistically significant.

Table 2: Mean attribute preference scores of five replicate samples.

Treatment	Aroma	Colour	Appearance	Flavour	Texture	Aftertaste	Acceptability
T1	6.14±0.29 <sup>a</sup>	6.60±0.29 <sup>a</sup>	6.75±0.30 <sup>a</sup>	6.83±0.32 <sup>a</sup>	7.11±0.30 <sup>a</sup>	6.09±0.30 <sup>ab</sup>	7.01±0.31 <sup>a</sup>
T2	6.38±0.29 <sup>a</sup>	6.42±0.29 <sup>a</sup>	6.78±0.30 <sup>a</sup>	6.72±0.32 <sup>a</sup>	6.87±0.30 <sup>ab</sup>	5.73±0.30 <sup>ab</sup>	6.70±0.31 <sup>ab</sup>
T3	6.18±0.26 <sup>a</sup>	7.40±0.26 <sup>b</sup>	6.92±0.27 <sup>a</sup>	6.56±0.28 <sup>a</sup>	6.86±0.27 <sup>ab</sup>	5.61±0.27 <sup>a</sup>	6.77±0.27 <sup>ab</sup>

\*Values followed by the same letters in each column are not significantly different ( $P>0.05$ )

#### IV. CONCLUSION

This study has revealed the importance of beef liver as a complimentary food for infants. The liver based infant foods are nutritionally preferred over the control sample and meat-based samples though there is no significant difference in acceptance. Comparison between commercially available samples could be performed with infants to evaluate overall consumer acceptance. Further investigation should be carried out to identify any potential enzymatic reactions between the ingredients before and after cooking, and their impact on nutrient quality and sensory attributes of the product.

#### ACKNOWLEDGEMENTS

This work was supported by governmental contestable funding from Ministry of Science and Innovation, New Zealand, and from the internal Strategic Science Investment Fund of AgResearch Limited (contract A19119).

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