Texture and nutrient content of commercial baby foods supplied in spouted pouches, compared to other packaging

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ABSTRACT

Objectives Complementary foods should have an increasingly solid texture and be more energy and nutrient dense than breast milk. This study aimed to measure the texture and nutrient content of ready-made wet commercial baby food (CBF) in spouted pouches, compared with other packaging, to evaluate their adequacy as complementary foods.

Design A cross-sectional survey measured all wet CBF available in six UK supermarkets using the International Dysphagia Diet Standardisation Initiative methodology, categorising them as liquids, purées or foods requiring any mastication. Nutrient content and age recommendations were transcribed from product packaging. Minimum desired energy, protein and maximal sugar content per 100 g were categorised in comparisons to breastmilk (sugar content ≤7 g/protein ≥1.2 g/energy density >70 kcal).

Setting UK.

Main outcome measures Texture, nutrient density.

Results 60% of the 298 wet CBF were delivered in spouted pouches (sPouches), of which 70% were targeted at children aged ≤6 months. Half (49%) were liquid, compared with 7% for other delivery systems. Most foods delivered less energy than breast milk (67% sPouches, 62% others) but sPouches were more likely to have lower protein content than breast milk (49% vs others 91%) and 61% had more sugar (other 8%). Only 8% of sPouches (32% others) were a purée or food that was more energy and protein dense than breast milk, but not sweeter, while 29% (2% others) met none of these criteria.

Conclusions Many wet CBF delivered in sPouches have the texture and composition of sweet drinks, while very few meet the desired characteristics for complementary foods.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Spouted pouches have become the dominant packaging for commercial baby foods. It is not clear whether these provide the necessary texture and nutrients to develop healthy complementary feeding skills.

WHAT THIS STUDY ADDS

⇒ An objective measure of texture suggested that half the foods in spouted pouches were liquids, and most are high in sugar and/or of low nutrient density, so not suitable for complementary feeding.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Regulators should review whether labelling spouted-pouch baby food products as complementary foods is appropriate and consider whether these delivery systems are inappropriate for complementary feeding.

INTRODUCTION

By the age of six months breast milk alone cannot supply all key nutrients and introduction of complementary foods should supply these in a more nutrient dense form. Good nutrition during the complementary feeding (CF) period is essential for establishing healthy food preferences, optimal growth trajectories and long-term health.[1] Poor diets during early childhood, in particular those high in sugar, have been associated with negative health outcomes later in life.

The WHO recommends that during CF, babies and young children should be exposed to a variety of nutritious foods, tastes and textures, alongside breastmilk or formula.[1 2] First foods offered should include good sources of iron, zinc and vitamin B12, and repeated and timely exposure to bitter flavours should be prioritised.[1] Textures should progress from smooth to lumpy, mashed or finger foods as soon as babies are ready.[3] This should be no later than 8–10 months to meet their food-related developmental milestones, such as chewing and moving food around in their mouth.[4] Sugary and sweet drinks, sweeteners and foods high in sugar, salt and trans fats should be avoided, and 100% fruit juice should be limited.[1]

The popularity of commercial baby foods (CBFs) rose with increasing birth rates after the Second World War[5] and the market has continued expanding and evolving since. A well-established body of research has highlighted recurring concerns with the CBF market over the years. Too many products favour sweet ingredients, are limited in energy content, and lack essential nutrients[6] or are too high in sugars.[7–10] They also often carry misleading marketing and labelling claims.[11] A decade ago, the CBF market consisted mostly of

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wet, soft, spoonable foods (purées), many of which were high in sugar and targeted at infants from age 4 months.[7 12] Recent trends show that purées still dominate the market,[6] but these are increasingly packaged in pouches with a spout.[13 14]

Baby food pouches with spouts are seen as a convenient option, and many caregivers believe that they are healthy options due to sophisticated marketing.[15] Pouches are widely used, with the latest figures from a survey of 1000 parents/carers in the UK suggesting that nearly 70% use purées or pouches either daily or a few times per week.[16] Ingredients in pouches must be highly puréed to pass through a small spout, which does not allow for larger or lumpier textures. However, research on the texture of CBFs, such as pouches has been mainly limited to what is reported in the packaging, for example, words such as soft, smooth, purée, lumpy.[6 7] To our knowledge, only one study has objectively evaluated the texture of CBFs, in the context of supporting patients with paediatric dysphagia.[17] This study aims to objectively evaluate the texture of baby food delivered via pouches compared with other wet baby foods marketed to young children in the UK, and to evaluate their nutritional content and suitability against CF recommendations.

METHODOLOGY

Study design

We conducted a cross-sectional study using a market survey design in six large UK supermarkets used in previous studies.[7 18 19]

Data collection

Data collection in supermarkets took place in October–November 2024. The selected supermarkets were all large/hypermarket types that offer a large variety of foods and serve families located in Glasgow, Scotland. All CBFs available in the baby food aisle that were wet, ready to eat and packed in plastic cups, pouches (with and without a spout), jars or plastic bowls were purchased. If different flavours of similar foods were available these foods were also included.

Product information variables

All information was transcribed from food packaging. The variables recorded included product name, brand, manufacturers' age recommendations, package type (delivery system), energy and any nutrient information provided. Mandatory nutrient information reported in food labels in the UK includes protein, total fat, carbohydrates, sugar and salt, but not micronutrient and these were rarely reported. Energy was recorded in kcal/100 g and nutrient contents in g/100 g.

Texture measurement

The International Dysphagia Diet Standardisation Initiative (IDDSI) methodology was used to objectively measure texture in CBFs.[20] The IDDSI classifies texture into eight levels[20] (see table 1). Liquids are classified from Level 0, thin to 4, extremely thick. The latter two overlap with food textures, with Level 3 being liquidised and 4 puréed foods. Level 5–7 then represent increasingly solid foods (see table 1). The tool uses three simple instruments to measure texture. A fork tests a food's firmness by lightly applying pressure to observe deformation as well as a thick liquid's capacity to pass though the tines. A spoon is used to test for food cohesion; testing the extent to which the food holds its shape on the spoon and the amount of residue left when the spoon was tilted. A syringe (without a needle) is used for thin liquids, but in this study none of the foods were thin enough, thus all textures were tested using metal spoon and fork. All baby food samples were measured for texture by one independent researcher (NT). A second measurement was done by one of two independent researchers RO and DLS, while blind to the first assessment. All foods were cold when texture was measured. The definition used for each category in this assessment is also shown in table 1.

Analysis

All variables were entered in an Excel spreadsheet and checked independently by another researcher (PC) for discrepancies and to corroborate that all data was entered correctly and to control for missing data. Data was analysed using SPSS IBM V.29.

The predictors examined were the delivery system and minimum recommended age. The primary outcome was texture. When comparing the paired ratings, 67.3% were identical and all but 1.5% varied by no more than ±1 point, so these numerical scores were averaged to create a mean score and recategorised to

Table 1 IDDSI texture assessment for applicable category definitions—abstracted from IDDSI manual[30]

	Category	Description	Applicable test	Definition
1	Slightly thick liquid	Thicker than water Requires a little more effort to drink than thin liquids	Syringe test	Flows with gravity through a 10 mL slip tip syringe leaving 1–4 mL in the syringe after 10 seconds.
2	Mildly thick liquid	Mild effort is required to drink through standard bore straw	Spoon tilt test	Pours quickly from a spoon, but slower than slightly thick drinks.
3	Moderately thick liquid/ liquidised food	No oral processing or chewing required Needs some tongue propulsion effort	Fork drip test	Drips slowly in dollops through the prongs of a fork, smooth texture no bite.
4	Extremely thick liquid Puréed food	Cannot be drunk from a cup or sucked through a straw No lumps Not sticky Does not require chewing	Spoon tilt test	Falls off spoon in a single spoonful when tilted leaving no more than thin film.
5	Minced and moist food	Can be eaten with a fork or spoon Biting not required. Minimal chewing required Tongue force required to move the bolus	Fork pressure test	Can be easily mashed with little pressure from a fork.
6	Soft and bite sized food	Can be eaten with a fork, spoon or chopsticks Soft, tender and moist chewing required before swallowing	Fork pressure test	Food can be mashed/broken down with pressure from fork.
7	Easy to chew food	Normal, everyday soft foods Requires the ability to bite, chew and orally process foods	Fork Pressure Test	Must break apart easily with the side of a fork or spoon.
8	Regular food	Regular food		

IDDSI, International Dysphagia Diet Standardisation Initiative.

reflect the average texture category as follows: <3 liquid, 3–<4 liquidised food or thickened liquid, 4–<5 purée, 5–7 soft food.

The energy, protein and sugar content were considered as secondary outcomes and compared with breast milk, since this is the sole food infants have consumed up to the onset of solid feeding. Since CF should supply key nutrients in a denser form than by lactation alone, the desired content of energy and protein should predominantly be higher than mature breast milk.[21] Breast milk is naturally quite sweet, but during CF non-sweet foods should be introduced[2] and foods with high sugar content avoided. We thus defined acceptable sugar content as being the same or lower than breast milk. A new large-scale study of human milk[22] suggests that by the age of 6 months the energy density IQR is 50–70 kcal/100 mL, protein content 0.68–0.95 g/100 mL and total carbohydrate 6.6 to 7.1 g/100 mL). Foods were therefore categorised relative to breast milk as follows:

Energy: <50 lower, 50–70 same, >70 more energy dense than breast milk.

Protein: <0.68 lower, 0.68–0.95 same >0.95 higher than breast milk.

Sugars: <6.6 g/100 g less sugar, 6.6–7 g same, >7.1 more sugar than breast milk.

We then defined foods as minimally suitable for CF if they were

1. A purée or solid food (IDDSI ≥4) which would enable development of solid feeding skills.
2. More energy and protein dense than breast milk.
3. Had a sugar content not higher than breast milk.

Table 2 Overall distribution of the food characteristics

	Suitability for complementary feeding	Categories	Number	%
Type of product		sPouch	178	59.7
		Pouch without spout	19	6.4
		Jar	27	12.4
		Tray	64	21.5
Minimum age (months)	Too early	4	53	17.5
	Timely	6	97	31.5
	Timely	7–10	106	35.6
	Too late	12–15	46	15.4
Food texture (IDDSI score)	Not suitable	Liquid (2)	21	7.4
	Not suitable	Thick liquid (3)	69	24.3
	Useful first food	Purée (4)	88	31.0
	Useful second food	Soft food (5–6)	106	37.3
Protein (g/100 g)	Too low	<0.68 g	55	18.5
	Same as breast milk	0.68–0.95 g	40	13.4
	Nutrient rich	>0.95 g	203	68.1
Total sugars (g/100 g)	**Lower than breast milk**	<6.6 g	175	58.7
	Same as breast milk	6.6–<7.1 g	7	2.3
	Higher than breast milk	7.1–<10 g	51	17.1
	Very high	≥10 g	65	21.8
Energy (kcal/100 g)	Too low	<50	29	9.7
	Same as breast milk	50–70	164	55
	Energy dense	>70	105	35.2

Bold descriptions indicate minimal suitability for complementary feeding.
IDDSI, International Dysphagia Diet Standardisation Initiative; sPouch, spouted pouch.

The categorised outcomes were compared by delivery system and age category using χ^2 and χ^2 trend.

RESULTS

There were 298 foods, from 16 manufacturers, of which 178 (59.7%) were delivered in spouted pouches (sPouches). All sPouches were marked as suitable for children under one, and two-thirds aimed at babies aged 6 months or less, whereas 46 (38.3%) of the remainder were aimed at infants aged 12 months or more (table 2).

Foods aimed at younger children were more likely to be presented in pouches and had higher sugar content (figure 1) than those provided for older children.

Food texture was rated by two assessors for 284 (95%) of foods. Half of the sPouches (49%) delivered liquids (score 1–3) compared with 6.8% of the remainder and only 10% were soft foods (77% remainder). Texture increased with recommended age (table 3).

Overall, the foods had a median (range) energy content of 66.5 (15-138) kcal/100 g and only 35.2% had an energy content greater than breast milk (65–70 kcal/100 g). The median (range) protein content was 2.3 (0.6–9.9) and sugar content 3.7 (0.8–16.4) g/100g.

Half (51.7%) of the foods in sPouches had a protein content higher than the breast milk range, but 29% were below it (table 4). In common with most of the foods, only around a third had energy density greater than breast milk, but 61% of the sPouch foods had higher sugar content than breast milk, compared with only 8% of the other foods (table 4).

Only 14 (8.4%) of foods in sPouches could be defined as fully suitable for CF, in that they met all the desired criteria for CF, being a purée or soft food that had less sugar content than breast milk but with higher protein and energy density; 48 (28.7%) met none of these criteria. This contrasted with the other wet CBFs, where 37 (32%) met all the desired criteria and only 2 (1.7%) met none.

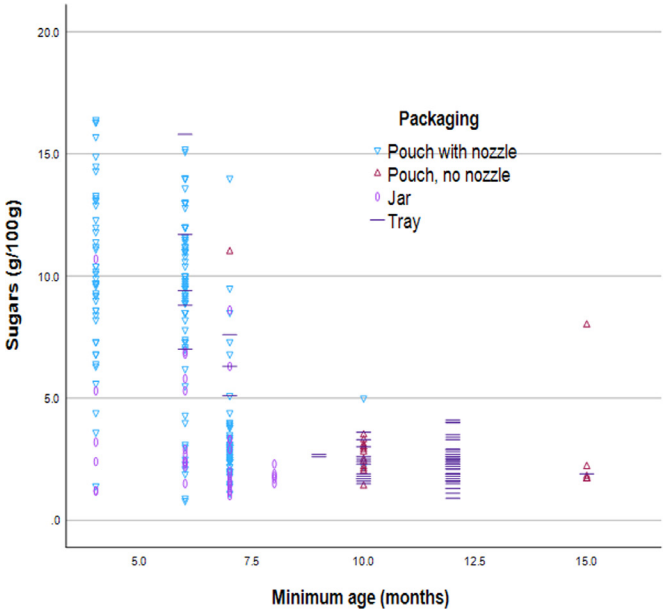

Figure 1 Association of delivery system with sugar content and minimum age.

Table 3 Association of texture with delivery system and age

Food texture (IDDSI score)	Liquid (1–3)	Purée (4)	Soft food (5–7)	P χ^2 trend
Minimum age				
4 months	37	13	0	
	74.0	26.0		
6 months	51	39	1	
	56.0	42.9	1.1	
7–10	2	36	62	
	2.0	36.0	62.0	
12–15	0	0	43	
			100.0	<0.001
Type of product				
sPouch	82	69	16	
	49.1	41.3	9.6	
Jar	0	0	19	
			100.0	
Pouch without spout	4	15	18	
	10.8	40.5	48.6	
Tray	4	4	53	
	6.6	6.6	76.9	<0.001
All non-sPouch packaging	8	19	90	
	6.8	16.2	76.9	

Values are number, row %.
IDDSI, International Dysphagia Diet Standardisation Initiative
sPouch, spouted pouch.

DISCUSSION

Our findings suggest that half the foods delivered in sPouches were liquid, two thirds delivered no more energy than breast milk and half delivered no more protein, while nearly two-thirds had more sugar. In contrast foods in other packaging were much more likely to be solid and more nutrient dense than breast milk, although only a third delivered more energy.

The texture and manner of CF is important. While suckling is an innate characteristic, the oromotor skills required for the manipulation of solid food in the mouth must be learnt experientially. For that reason, CF recommendations suggest that first foods offered should progress from purées to lumpy, mashed and finger foods.[3] Trial evidence at this age is scarce, but a small, randomised control trial found that infants aged 8 months exposed to larger and harder food over a 4-week period were more capable of chewing than those exposed to softer and smaller pieces.[23] For pouches specifically, not only do they deliver a thin food that can be swallowed with little oromotor manipulation, but they are also often consumed by sucking from the spout, rather than from a spoon.[24]

A 2024 observational study found that frequent baby food pouch use was associated with fussy eating behaviours later on.[24] This was an observational study and thus intrinsically at risk of reverse causality, whereby children who were naturally fussy eaters or slower at reaching developmental milestones may have been introduced to lumpy foods later as a result. However, in a trial of baby-led CF, which randomised infants to timely CF with immediate introduction to solid foods, infants who self-fed solid foods were less fussy and enjoyed foods more compared with those following traditional spoon-feeding.[25]

During processing, highly puréed foods release intrinsic sugars as the cell walls of fruits and vegetables are broken down.[1] This means that smoother texture products are likely to be higher in free sugars. High sugar intakes in early childhood have long-term health implications, both in terms of dental health and overweight. Data published in 2024 found that tooth decay was the leading cause of hospitalisation in children aged 5–9 years old in England.[26] Data from participants with experience of sugar rationing in early childhood has also suggested an association of lower sugar intake with a reduced risk for type 2 diabetes, heart disease and respiratory health.[14 27]

We found that pouches were a particularly common delivery system offered for the youngest children, in whom teeth are yet to erupt. However, without an upper age limit, these products are likely also consumed at later ages after the first teeth have begun to erupt. Although it is not recommended, it seems likely that many children suck directly from sPouches.[28] It has long been known that consuming sugary drinks directly from a bottle greatly increases the risk of dental caries.[2]

An important characteristic of complementary foods is that they should supply more energy and other essential nutrients than milk alone, to meet the child's growing nutritional needs.[1] Worldwide, foods aimed at young children are often less energy dense than breast milk, due to their high water content, and commonly also lack adequate iron or iodine.[1] Thus the WHO recommends that CF should prioritise animal-source foods, nuts, pulses and seeds as well as fruits and vegetables.[1 29] They also counsel against using sugar to supply 'empty energy', so infant drinks other than breastmilk, infant formula or (from 6 months) water are discouraged, particularly fruit juices which are high in free sugars.[1 30] Therefore, these CBFs, which in texture and content are equivalent to fruit smoothies, should not really be given at all before 12 months and their intake limited after.[2]

Parents/carers who choose to feed their infants CBF do it for reasons such as convenience and the perception of food safety, but also due to misperceptions of suitability and healthfulness.[15] CBF packaging often displays the misleading claim 'no added sugar' despite containing high amounts of free sugars due to puréed fruit content.[14] Concerns have also been raised about the potential for baby food pouches to displace breast milk when introduced before 6 months.[14 31]

To address these concerns WHO Europe recently published guidelines on the Nutrient and Promotion Profile Model (NPPM) for CBFs. Their recommendations are similar, but not identical to the criteria we have used in this paper, and the NPPM sets different thresholds for different types of foods—such as puréed vegetable versus fruit purées—and based them more on what was deemed 'normal' for food of that type. Thus, for wet foods NPPM set a threshold of 0.6 g kcal/g, which is lower than that of breast milk (0.7 kcal/g). However the WHO recommendations, based on calculated requirements and estimated stomach capacity suggest that CF should have an average energy density 33–66% higher than that of breast milk.[21] This paper thus uses a threshold midway between the two. In contrast NPPM set a more stringent threshold for sugar content, 5% which is lower than that of breast milk. The result is that other recent studies have already reported that most CBFs do not meet NPPM guidelines.[32–34]

Strengths and limitations

The strength of this study is the objective measure of texture in a large sample of CBFs that was representative of what parents have access to from large supermarkets in the UK. We used a validated, simple assessment, although for the clinical context of dysphagia and compared food delivered in pouches to more traditional packaging.

Table 4 Association of delivery system with age, sugar, protein and energy content

Type of product	sPouch	Jar	Pouch	Tray	All non-sPouch packaging	P χ^2 trend
Minimum age						
	46	6	0	0	6	
4 months	25.8	16.2	0.0	0.0	5.0	
	78	11	0	5	16	
6 months	43.8	29.7	0.0	7.8	13.3	
	54	20	14	18	52	
7–10	30.3	54.1	73.7	28.1	43.3	
	0	0	5	41	46	
12–15	0.0	0.0	26.3	64.1	38.3	<0.001
Protein (g/100 g)						
<0.68 g	52	1	0	2	3	
	29.2	2.7	0.0	3.1	2.5	
0.68–0.95 g	34	4	0	2	6	
	19.1	10.8	0.0	3.1	5.0	
>0.95 g	92	32	19	60	111	
	51.7	86.5	100.0	93.8	92.5	<0.001
Total sugars (g/100 g)						
<6.6 g	67	33	17	58	108	
	37.6	89.2	89.5	90.6	90.0	
6.6–<7.1 g	4	2	0	1	3	
	2.2	5.4	0.0	1.6	2.5	
7.1–<10 g	46	1	1	3	5	
	25.8	2.7	5.3	4.7	4.2	
≥10 g	61	1	1	2	4	
	34.3	2.7	5.3	3.1	3.3	<0.001
Energy content (kcal/100 g)						
<50	23	5	1	0	6	
	12.9	13.5	5.3	0.0	5.0	
50–70	96	25	10	33	68	
	53.9	67.6	52.6	51.6	56.7	
>70	59	7	8	31	46	
	33.1	18.9	42.1	48.4	38.3	<0.001

Value are number, column %.
sPouch, spouted pouch.

The assessment of food texture was done on cold samples, where savoury meal type dishes would usually be heated, which might influence viscosity and change the texture estimation. However, a study testing texture in foods prepared in a hospital kitchen showed that heating standardised foods like porridge made them more liquid.[35] Thus, if these foods had been heated the proportion which were liquid might have been even greater.

The assessment of the nutrient content of the foods was limited to the information provided by the manufacturers. This was largely complete for toal sugars, protein and total energy, but iron content in particular was rarely stated, although this is a key micronutrient required when commencing CF.

While this analysis gives a comprehensive view of the market, we lack information on actual consumption levels. However, a recent scoping review found that pouch use is widespread.[36] The CBF market is dynamic and foods that were included in this analysis might vary with time and from country to country. Still, from our previous studies we have observed that sPouches have become a predominant feature in the baby food market over the past decade.[6]

In conclusion, products delivered in sPouches generally do not meet the desired characteristics of complementary foods. Many are more similar to sweet fruit smoothies, which are not recommended at all for babies or preschool children.[30] Official public guidance on CF already discourages the use of sPouches over other delivery systems. Our findings suggest that regulators should consider whether a change in product categorisation and labelling is needed to make clear which products are foods and which are drinks, to discourage the use of sPouches and to enable parents to make informed choices in line with public health recommendations for feeding infants and young children.

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