gastronomy

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Sensory and Emotional Profiling of Different Processed Oat Products—A Pilot Study

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Abstract

This study aims to compare differently processed oat products in terms of sensory and emotional perceptions by trained and untrained observers. A descriptive analysis was carried out for sensory profiling, and a hedonic test was conducted by 26 mothers. The Empathic Food Test (EFT) was used by trained subjects and 15 mothers for emotional profiling. Four products were compared: two products approved for infants (Holle and Hipp); one hydrothermally processed whole-meal oat flour (TAU®); and oat flakes (Bauck). The sensory descriptive analysis revealed that the products for infants clearly differed from the other products in terms of their significantly lower aroma and flavor intensity. The TAU® and Bauck products varied widely in their sensory properties regarding bitterness, sweetness, taste, and smell. The emotional profiling conducted by trained observers revealed differences between the infant products and the other products. TAU® and Bauck scored higher than the two products approved for infants. Consumer tests indicate slightly greater differences in emotional profiling compared to hedonic sensory profiling. Intensively processed oat products can be clearly distinguished from less processed ones via sensory and emotional profiling. The results were more distinct for trained observers. Due to the small sample size, the generalizability of the results needs to be verified by further research.

Keywords: sensory profiling; emotional profiling; oat processing

1. Introduction

The past 10 years have seen a growing debate about ultra-processed foods (UPFs) and their effects on health. Links between the consumption of UPFs and chronic diseases have already been described [1,2]. Several systems have been developed to define the processing intensity of foods [3]. The most widely used of these is the NOVA system developed by Monteiro et al. [4], which is controversial because there are no criteria for objectively classifying products according to their degree of processing and nutritional quality [5,6]. The NOVA system addresses cereal processing; however, not all processes are described in detail [4], as some are summarized as breakfast cereals. According to the NOVA system, baby products are defined as ultra-processed foods. The instant property of cereal porridge products is associated with intensive processing via spray drying or roller drying.

The global market for baby food was worth USD 109.02 billion in 2024 [7]. In the European Union, food products for babies and young children are regulated by Directive 2006/125/EC of 5 December 2006 [8]. The directive stipulates a minimum level of nutrient

Check for updates

Academic Editor: Gabriella Morini

Received: 29 October 2025
Revised: 23 January 2026
Accepted: 24 February 2026
Published: 5 March 2026

 https://doi.org/10.3390/gastronomy4010006

content that these products often fail to meet, meaning that many products must be supplemented. In the case of cereal porridge, for example, it lacks vitamin B1.

One aspect that has received little attention in the evaluation of food processing is the sensory experience of the products by the target audience, i.e., the effects of the products on sensory and emotional well-being.

While sensory descriptions of taste, aroma, and mouthfeel are well established and regulated by ISO standards (e.g., ISO 13299 and ISO 8586) [9,10], methods for describing their effects of food on physical and emotional well-being are still relatively new. Several questionnaires focusing on the perceptions of food-induced emotions have been developed [11–13]. Food-induced emotion measurement is used to assess quality questions, such as evaluating new ingredients [14], the importance of portion size [15], and comparing yogurt [16] and milk product attributes [17].

Sensory analysis is a commonly used method for evaluating grain processing stages. To the best of our knowledge, no studies have evaluated the sensory properties of grain-based baby food. Venter et al. (2025) [18] examined how microwaves and decortication alter the sensory properties of sorghum. Onyeoziri et al. (2021) [19] investigated how pearl millet can be stabilized for storage over several months through pre-processing such as extrusion cooking. Adebowale et al. (2020) [20] examined how microwave treatment can reduce the rancidity of whole-grain sorghum flour, while Rani et al. (2020) [21] compared different roasting methods for multigrain extruded flakes in terms of sensory acceptance. Kebakile et al. (2008) [22] investigated grinding techniques by evaluating the sensory characteristics of sorghum porridge.

Even though emotional profiling has increasingly been used in product evaluation [23,24], only a few studies on the evaluation of grain processing are available. Bartkiene et al. (2021) [25] compared extruded and fermented wheat bran as bread additives, Wohlers et al. (2024) [26] proved that both value-giving ingredients and the emotional profiling (EP) of breakfast cereals change during processing. Flake production was a gentler process than extrusion and popping in terms of ingredients and EP.

This study examined whether oat products for infants and comparable products that undergo different processing methods vary in terms of their sensory and emotional profiles. All four products consisted of 100% oats, apart from vitamin B1 supplements in the two baby products. The baby products were dried using roller drying. One product, which was hydrothermally broken down, was also in powder form. The fourth product was flakes. Expert panels were used for sensory and emotional profiling. Additional testing was carried out with consumers.

2. Materials and Methods

Four organically produced products were compared (Figure 1): two products approved for infants, enriched with vitamin B1 (Holle: Holle baby food AG, Riehen, Switzerland; Hipp: Hipp GmbH & Co KG, Pfaffenhofen, Germany); whole-meal oat flour (TAU®: ErdmannHauser Getreideprodukte GmbH, Erdmannhausen, Germany), which was broken down using its own enzyme activity with water and heat (hydrothermal); and oat-flake porridge (Bauck: Bauck GmbH, Rosche, Germany) (Table 1). In all experiments, the samples were coded with a three-digit code and randomized. The product names remained unknown. Samples of these products were sent to laboratories for chemical analysis, sensory profiling, and emotional profiling. For the consumer home test, 40 g of each sample was packaged in a plastic bag for shipping. The label included a recipe for preparation.

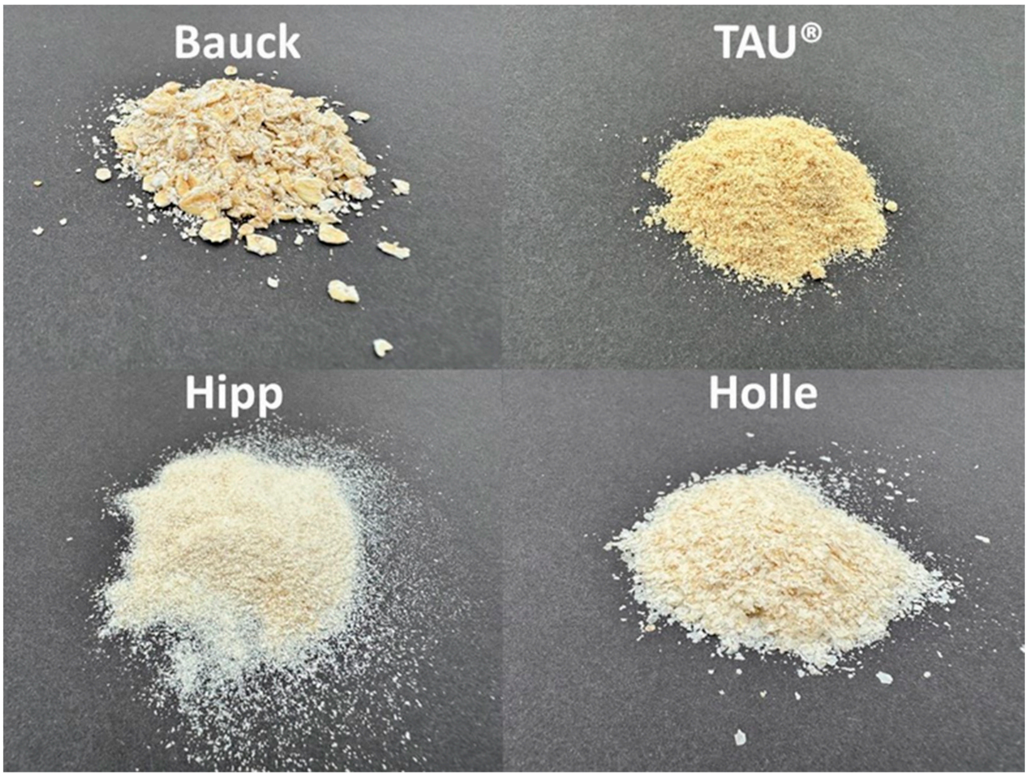

Figure 1. The appearance of the four products.

Table 1. Oat samples.

Variant	Product	Processing	Farming Method
Hipp	Hipp Bio Getreidebrei, HiPP GmbH & Co. KG, 100% wholegrain oat flour with thiamin supplement (carbohydrates 71.2%, protein 12%, fat 7%, fiber 7.8%)	Roller drying	Organic
Holle	Holle Bio, Mein allererster Brei, Holle Europe GmbH, 100% wholegrain oat flour with thiamin supplement (carbohydrates 64%, protein 14%, fat 6.5%, fiber 9.1%)	Roller drying	Organic (Demeter)
Bauck	Bauck Mühle Hot Hafer Basis Porridge, Bauck GmbH, 100% Oat (carbohydrates 60%, protein 13%, fat 6,7%, fiber 9.7%)	Flaking	Organic (Demeter)
TAU®	TAU® Getreidebrei aus Hafer, ErmannHAUSER Getreideprodukte GmbH, 100% Oat (carbohydrates 62%, protein 12%, fat 4.8%, fiber 9.9%)	Hydrothermal grain milling	Organic (Demeter)

The samples were prepared according to the manufacturer's instructions. A 40 g sample was used. For the Hipp and Holle samples, fresh drinking water was first boiled. Then, 200 mL of this was poured into a bowl and left to cool for 15 min. The samples were then added and stirred. For the Bauck sample, the flakes were placed in a bowl, 100 mL of hot water was added, stirred, and left to soak for 2 min. For the TAU sample, the powder was stirred into 200 mL of cold water, brought to a boil while stirring, simmered for one minute, and then transferred to a bowl. The samples for the expert panels were presented in glass bowls. The samples for the consumer and expert tests were coded with three-digit codes and randomized.

Conventional sensory profiling (according to DIN EN ISO 13299) [9] was carried out by 12 members of the Döhler panel. The profiling took place in the sensory lab of Döhler Sensory & Consumer Science in Darmstadt. All panelists were trained according to DIN EN ISO 8586 [10]. The panelists underwent 4 training sessions. This familiarized them with the product range and enabled them to select relevant attributes. The samples were offered at approximately 40 degrees Celsius (TAU® with 2 degrees slightly warmer, due to skin formation). The neutralization between samples was carried out with water. They were measured on a scale of 0 (not perceptible) to 7 (very strong). The sensory software FIZZ Data [27] was used for collection and analysis. Statistical analyses were conducted using XLstat [28].

Physical and emotional responses to the samples were determined using the Empathic Food Test (EFT) questionnaire [29]. Emotional profiling was performed with 13 trained observers (average age of 49.8; 10 females and 3 males). All observers had experience from more than 10 experiments. Three training sessions were held with differently processed grain products. The neutralization between samples was carried out with water. The EFT questionnaire generated two types of results: First, a free description of the initial impression of food degustation on participants' physical and emotional well-being was generated. Second, questions about 12 polar characteristics (see Table 2), which were rated on a five-point scale of "easy" (score 1), "rather easy", "neutral", "rather difficult", and "difficult" (score 5), were asked. Based on a factor analysis, five of the 12 items can be grouped into two scales (resp. mean scores): scale 1 comprised five more emotionally oriented items, while scale 2 was composed of five items that focused on physical and mental effects [29]. The free description captured the effects of the product as determined by the participants' first impressions. The free description also recorded characteristics that went beyond the 12 polar items. The procedure is comparable to the description of likes/dislikes in the hedonic consumer test. Text analysis was used to record the number of identical observations. Similar characteristics, such as being alert and focused, can be grouped together in a cluster.

Table 2. Twelve polar items of the EFT questionnaire and their corresponding factor scales [29].

	Polar Items		**Scale**
I feel...	Warm	Cold	-
	Bright	Dark	1
	Light	Heavy	2
	Fresh	Exhausted	2
I feel...	Energized	Not energized	2
	Awake	Sleepy	2
	Concentrated	Distracted	2
	Relaxed	Nervous	1
	Comforting	Unwell	1
	Satisfied	Unsatisfied	1
	Balanced	Unbalanced	1
The impact feels...	Long lasting	Short	-

For consumer testing, we searched for test subjects in the spring of 2025 by communicating with preschools near Erdmannhausen (Germany) and leveraging a mailing list of the Working Group for Nutrition Research (Arbeitskreis für Ernährungsforschung, Bad Vilbel, Germany). Thirty-two people signed up for the trial. The participants were introduced to the study through two video conferences, during which the products to be tasted were not mentioned. The video conference also integrated an introduction to the Empathic Food Test, including a body scan and a tasting of two water samples, alongside a discussion. The four coded samples were sent by post to the 32 participants (all females). The package contained a procedure plan and a questionnaire on consent to data use. The questions focused on age, gender, and the consumption of oat products. The samples (40 g each) were placed in a plastic bag with a sticker bearing a code and a recipe for preparation. Twenty-six people returned the questionnaires. Among the 26 participating women (average age 40.5.) were 24 mothers with young children and two grandmothers. Five of these mothers had been breastfeeding at the time of the survey. All participants consumed oat products (13 consumed them often, 9 consumed them regularly, and 4 consumed them rarely). Almost all the participants' children (or grandchildren) consume oat products (10 consumed them often, 10 consumed them regularly, and 5 consumed them rarely). In the consumer test, the participants were first asked to complete the emotional profiling questionnaires and then, after a break, the sensory profiling. The same questionnaire used for the trained observers was applied to emotional profiling. The questionnaire for the sensory consumer test asked about appearance, smell, texture, aroma, and taste on five-point scales (from 1 = "very pleasant" to 5 = "very unpleasant"), and overall impression or willingness to buy (from 1 = "I would buy" to 3 = "I would not buy"). One comparative study [30] showed that experience and the length of the introduction to EFT influence results. The results for comparisons of pairs of food varied depending on whether consumers were not prepared at all, prepared briefly (0.75 h), or prepared extensively (4 h). This was probably because consumers were unfamiliar with the perception of food-induced emotions and had to first be trained to distinguish these perceptions from taste.

The consumers did not receive any training, only preparation. This included an explanation of the test procedure and the principles of empathic food testing, with attention paid to the differences between the perception of taste, smell, and mouthfeel on the one hand, and the effects on physical and emotional well-being on the other. After an introductory body scan, a pair of still waters was tasted, and the perceptions were subsequently discussed. The online introduction to EFT for consumers was very short, lasting approximately 50 min. Only one sample pair was tasted. Considering the above, there was a risk that not all participants would be able to distinguish between taste and effect on well-being on their first attempt. This was confirmed by the results of the free description results. Eleven participants noted only sensory terms, even though the questionnaire explicitly asked about physical and emotional well-being. Therefore, the results of these individuals were not included in the EFT evaluation.

The four samples were tested for acrylamide, amino acid spectrum, vitamin B1 (thiamine), and vitamin B9 (total folates) in a testing laboratory accredited according to ISO/IEC 17025:2018 [31]. Test method: Determination of acrylamide in food using LC-MS/MS (PAW 057, 2024-11) [32]. Limit of quantification: 10 µg/kg. Gravimetric determination of the fat content in food and feed materials (PAW 002, 2023-11) [33] and gas chromatography of fatty acid methyl esters: Part 2, production of fatty acid methyl esters in animal and vegetable fats and oils according to ASU L 13.00-27/2, 2019-07 [34] and Part 4, determination by capillary gas chromatography according to ASU L 13.00-46; 2018-06 [35]. Detection by GC-FID (PAW 011) [36]. Determination of free amino acids using LC-MS/MS, SOP M 3123 (2022-04) [37]. Determination of vitamin B1 using LC-FLD according to EN 14122:2014 mod. [38] Determination of folic acid using nephelometry according to NMKL 111:1985, 870 [39].

A linear mixed model was used to analyze the EP results. Item-related mental and physical effects served as dependent variables. The variants were modeled as fixed factors, while "person" was considered a cluster variable. The significance level was set to

$p < 0.05$. To analyze the free descriptions, a Friedman test for paired samples was used to check whether the number of characteristics mentioned differed significantly between the treatments. JAMOVI version 2.6.44.0 (2025) software was used for the calculations [40].

3. Results

3.1. Sensory Profiling

Of the four samples examined, two produced very similar results, while two gave significantly different results (Table 3). No "off notes" were detected in any of the four products. Bitterness was only slightly pronounced. Hipp oatmeal and Holle oatmeal present similar sensory profiles. The main difference lies in their appearance: Hipp oatmeal is slightly thinner than Holle oatmeal and adheres slightly more to the spoon. In terms of taste, Holle oatmeal is fluffier, and its mashed-apples taste is slightly more pronounced. Both brands of oatmeal deliver low-to-medium cereal and nutty flavors. They taste slightly sweet and bitter, and they have thin, slippery, mushy, and fluffy textures. Bauck oatmeal porridge has a thick, sticky, slimy, compact, and not homogenous texture. It delivers a medium cereal and nutty flavor, and its taste is slightly sweet and not bitter at all. TAU® oatmeal has a homogeneous, slimy, mushy, thin, and slippery texture. It delivers medium-to-strong cereal and nutty flavors with malty and herb/hay notes. Its taste is less sweet than the other products and slightly bitter. The term "herb/hay" is also associated with the impression of whole-meal bread. TAU® oatmeal displays a high degree of complexity because many characteristics typical of cereal are pronounced.

Table 3. Results of the sensory descriptive analysis. Mean values. Letter differences indicate significant effects. Scale: 0 ("not perceptible") to 7 ("very strong").

	Attribute	TAU®	Bauck	Hipp	Holle
Aroma	Overall smell	5.2 a	4.2 b	3.3 c	3.1 c
	Cereal	5.0 a	4.3 b	3.6 c	3.4 c
	Nutty	3.1 a	2.8 ab	2.5 b	2.5 b
	Herb/hay	2.5 a	1.6 b	1.2 b	1.2 c
	Malty	2.8 a	0.9 b	0.5 c	0.5 c
	Mashed apples	0.4 b	0.5 b	1.6 a	1.8 a
Taste	Overall taste	4.9 a	4.0 b	3.2 c	2.9 c
	Cereal	4.7 a	4.2 b	3.5 c	3.2 c
	Nutty	2.5 a	2.2 a	2.2 a	2.1 a
	Herbs/hay	2.5 a	1.7 b	1.2 c	1.2 c
	Malty	2.4 a	0.8 b	0.6 b	0.5 b
	Mashed apples	0.3 c	0.3 c	1.3 b	1.6 a
	Sweet	1.6 c	2.5 a	2.1 b	2.1 b
	Bitter	1.9 a	0.8 b	1.7 a	1.9 a
Appearance	White (0) → brown (7)	5.9 a	4.1 b	1.9 c	2.1 c
	Adherence spoon	4.1 b	4.7 a	2.4 c	1.0 d
	Thin (0) → thick (7)	3.4 b	6.0 a	2.7 c	3.2 b
	Fluffy (0) → compact (7)	4.6 b	6.3 a	2.1 c	1.4 d
	Mushy	4.6 b	0.4 c	6.1 a	5.8 a
	Homogenous	4.9 b	0.8 c	5.7 a	5.2 ab
	Quantity swollen flak	0.3 b	6.8 a	0.1 c	0.1 c
	Slimy	2.6 b	4.2 a	1.1 c	0.9 c

Table 3. *Cont.*

	Attribute	TAU®	Bauck	Hipp	Holle
Texture	Slippery	3.2 b	1.3 c	5.2 a	5.5 a
	Sticky	4.2 a	4.3 a	1.5 b	1.3 b
	Thin (0) → thick (7)	4.1 b	5.7 a	2.7 c	2.4 c
	Slimy	3.6 a	4.0 a	1.2 b	1.2 b
	Mushy	4.3 b	0.9 c	6.2 a	6.1 a
	Fluffy (0) → compact (7)	4.4 b	6.3 a	1.7 c	1.1 d
Mouthfeel	Covering	4.6 a	3.0 b	2.1 c	1.8 c
	Powdery	2.4 a	1.0 b	1.4 b	1.2 b
	Homogenous	3.9 b	1.1 c	5.6 a	5.4 a
	Quantity swollen flak	0.4 b	6.7 a	0.1 c	0.1 c

3.2. Emotional Profiling

Emotional profiling using EFT revealed significant differences between the products. Effects were identified in nine out of the 12 bipolar items and the two mean scores (Table 4), as well as in several characteristics of the free description (Table 5). Two groups can be distinguished: oatmeal from Holle and Hipp, and products from TAU® and Bauck. The biggest differences were between Holle and TAU® and between Hipp and TAU®. In the two EFT mean scores (emotional and body) and four individual items, the oatmeal from TAU® was rated significantly more favorably than the oatmeal offered by Holle and Hipp (Table 5). Significant differences were also identified between Bauck and Holle (EFT mean score emotional and four individual items). The comparisons between Bauck and Hipp were less pronounced (EFT mean value—emotional and one item).

Table 4. Differences between the four oat products with respect to Empathic Food Test questionnaire parameters (panel of 13 trained observers).

Parameters	Bauck *	Hipp *	Holle *	TAU® *	*p*-Value
I feel warm (1)/cold (5)	2.23 (±0.55)	2.31 (±0.55)	2.08 (±0.55)	1.31 (±0.55)	**0.023**
I feel light (1)/dark (5)	1.85 (±0.54)	2.69 (±0.54)	2.69 (±0.50)	1.75 (±0.50)	0.095
I feel light (1)/heavy (5)	2.85 (±0.54)	2.85 (±0.76)	2.85 (±0.90)	2.46 (±0.54)	0.818
I feel refreshed (1)/exhausted (5)	2.46 (±0.54)	3.23 (±0.46)	3.31 (±0.53)	2.31 (±0.48)	**0.026**
I feel motivated (1)/unmotivated (5)	2.38 (±0.63)	3.08 (±0.63)	3.00 (±0.63)	2.08 (±0.63)	**0.049**
I feel awake (1)/sleepy (5)	2.38 (±0.65)	2.85 (±0.65)	3.08 (±0.65)	2.00 (±0.65)	**0.021**
I feel concentrated (1)/distracted (5)	2.31 (±0.60)	3.15 (±0.60)	3.08 (±0.59)	2.15 (±0.60)	**0.041**
I feel relaxed (1)/nervous (5)	1.69 (±0.64)	3.08 (±0.63)	2.92 (±0.64)	1.85 (±0.63)	**0.003**
I feel comforting (1)/unwell (5)	2.15 (±0.67)	3.15 (±0.67)	3.38 (±0.67)	1.85 (±0.66)	**0.004**
I feel satisfied (1)/unsatisfied (5)	2.23 (±0.61)	3.00 (±0.61)	3.38 (±0.61)	1.85 (±0.60)	**0.003**
I feel balanced (1)/unbalanced (5)	2.15 (±0.72)	3.31 (±0.71)	3.69 (±0.71)	1.92 (±0.71)	**0.002**
I feel the effect long (1)/short (5)	2.46 (±0.49)	2.77 (±0.48)	2.54 (±0.48)	2.38 (±0.49)	0.599
EFT mean score—emotional	2.02 (±0.55)	3.05 (±0.55)	3.22 (±0.55)	1.97 (±0.55)	**0.002**
EFT mean score—body	2.48 (±0.47)	3.03 (±0.4)	3.06 (±0.47)	2.20 (±0.47)	**0.016**

* Values are mean (confidence interval).

The free-description results revealed a similar pattern to that seen in the 12 bipolar questions (Table 6). The biggest differences were between TAU® and Holle, and TAU® and Hipp. The number of negatively connoted observations (TAU® mean 0, SD 0) was significantly higher for Hipp (mean 1.615, SD 1.04) and Holle (mean 2.385, SD 1.04), and the number of positively connoted observations was significantly lower than for TAU® (mean 4.08, SD 0.954; Holle mean 1, SD 0.816; Hipp mean 1.69; SD 0.855). The positively connoted clusters "chest" (TAU® mean 0.692, SD 0.63; Holle mean 0, SD 0, Hipp mean 0, SD 0), "relaxed" (TAU® mean 0.692, SD 0.63; Holle mean 0, SD 0, Hipp mean 0.308, SD 0.48), and "alert" TAU® mean 1.0, SD 0.577; Holle mean 0.154, SD 0.376, Hipp mean 0.308, SD 0.48) were also significantly more pronounced for TAU® than for Holle and Hipp. The cluster "stabilizing" TAU® (mean 0.846, SD 0.376) differed from the same cluster for Hipp (mean 0.385, SD 0.506).

Table 5. Post hoc analysis of the analysis of pairs of variants with respect to Empathic Food Test questionnaire parameters (panel of 13 trained observers).

	Difference	SE	*p*-Value
Differences between TAU® and Holle			
I feel alert/tired	1.077	0.355	**0.027**
I feel relaxed/nervous	1.077	0.429	0.05
I feel well/unwell	1.538	0.464	**0.013**
I feel satisfied/unsatisfied	1.538	0.417	**0.004**
I feel balanced/unbalanced	1.769	0.5	**0.007**
EFT mean score—emotional	12.462	0.384	**0.015**
EFT mean score—body	0.8615	0.303	**0.044**
Differences between TAU® and Hipp			
I feel relaxed/nervous	1.231	0.429	**0.034**
I feel well/unwell	1.308	0.464	**0.039**
I feel satisfied/unsatisfied	1.154	0.417	**0.045**
I feel balanced/unbalanced	1.385	0.50	**0.035**
EFT mean score—emotional	10.769	0.384	**0.032**
EFT mean score—body	0.831	0.303	**0.048**
Differences between Bauck and Holle			
I feel relaxed/nervous	1.231	0.429	**0.016**
I feel well/unwell	1.231	0.464	**0.047**
I feel satisfied/unsatisfied	1.154	0.417	**0.045**
I feel balanced/unbalanced	1.538	0.50	**0.02**
EFT mean score—emotional	12.000	0.384	**0.035**
Differences between Bauck and Hipp			
I feel relaxed/nervous	1.385	0.429	**0.034**
EFT mean score—emotional	10.308	0.384	**0.033**

p-values in bold indicate statistical significance. SE: standard error.

Table 6. Post hoc analysis of the analysis of pairs of variants with respect to Empathic Food Test free descriptions observations.

	p-Value	
Differences between TAU® and	**Holle**	**Hipp**
Total negative observations [1]	**<0.001**	**<0.001**
Total positive observations [2]	**<0.001**	**<0.001**
Cluster "chest" [3]	**<0.001**	**<0.001**
Cluster "relaxed" [4]	**0.001**	ns
Cluster "alert" [5]	**<0.001**	**<0.001**
Cluster "stabilizing" [6]	ns	**0.028**
Differences between Bauck and	**Holle**	**Hipp**
Total negative observations	**<0.001**	**<0.001**
Total positive observations	**<0.001**	**<0.001**
Cluster "relaxed"	**0.041**	ns
Cluster "alert"	**<0.001**	**<0.001**

Table 6. *Cont.*

	p-Value
Differences between Bauck and TAU®	
Total negative observations	**<0.001**
Total positive observations	**0.022**
Cluster "chest"	**<0.001**
Differences between Hipp and Holle	
Total negative observations	**0.017**
Total positive observations	**0.048**

[1] Total of negatively connoted observations. [2] Total of positively connoted observations. [3] The cluster comprises the observations "chest widens", "breath deepens", and "embraces". [4] The cluster comprises the observations "relaxed", "well", and "calm". [5] The cluster comprises the observations "alert", "concentrated", "bright", and "upright". [6] The cluster comprises the observations "strengthening", "stabilizing", and "good standing".

There were still relatively large contrasts between Bauck and Hipp and between Bauck and Holle, namely the number of negatively connoted observations (Bauck mean 0.692, SD 0.48), the number of positively connoted observations (Bauck mean 3.08, SD 0.76), the cluster "alert" (Bauck mean 1.0, SD 0.577), and the cluster "relaxed" (Bauck mean 0.385, SD 0.506) (Table 6). TAU® was rated more favorably than Bauck in terms of the number of positively connoted observations and the cluster "chest". Hipp and Holle differed in the number of negatively connoted observations (Table 6).

3.3. Consumer Testing—Hedonic Sensory Test

Twenty-six participants took part in the hedonic sensory test. Sensory profiling was carried out after emotional profiling was completed. The sensory consumer test questionnaire asked participants about appearance, smell, texture, aroma, taste, and overall impression or willingness to buy.

There were no differences between the four products in terms of overall impression and texture/mouthfeel. The greatest effects were observed in appearance (Table 7). TAU® was rated less favorably than the three comparison products (TAU® mean 3.40, CI ±0.37; Bauck mean 1.84, CI ±0.37; Hipp mean 2.40, CI ±0.37; Holle mean 2.20, CI ±0.37). There were also differences between Bauck and TAU® in terms of smell and taste (Table 7). Bauck was rated more positively (Bauck smell mean 1.88, CI ±0.34, TAU® smell mean 2.48, CI ±0.34) (Bauck taste mean 2.04, CI ±0.48; TAU® taste mean 2.48, CI ±0.47). Only by trend (p = 0.074), the aroma of TAU® was rated more favorably than that of Holle.

Table 7. Post hoc analysis of the analysis of pairs of variants with respect to hedonic sensory testing (SE: standard error).

	Difference	SE	*p*-Value
	Differences between TAU® and Holle		
Appearance	1.200	0.264	**<0.001**
	Differences between TAU® and Hipp		
Appearance	1.000	0.264	**0.001**
	Differences between Bauck and TAU®		
Appearance	1.560	0.264	**<0.001**
Smell	0.60	0.212	**0.036**
Texture/mouthfeel	11.19	0.332	**0.007**

3.4. Consumer Testing—Emotional Profiling

Twenty-six mothers took part in the consumer test for sensory and emotional profiling. Only the 15 participants who had recorded the effect on their physical and emotional well-being in the free description were included in the evaluation. The 11 people who had only noted taste impressions were excluded from the evaluation.

Only one among the 12 polar questions of the EFT showed significant effects, warm/cold (Table 8): The TAU® product was perceived as significantly warmer (mean 1.80, CI ±0.60) than the products from Hipp (mean 3.33, CI ±0.61) and Holle (mean 3.07, CI ±0.61). The Bauck product (mean 2.07, CI ±0.61) was described as warmer than the Hipp product (Table 8). The effect size *dmod* for the differences identified was large (Bauck–Hipp, −1.076; Holle–TAU®, 1.076) to very large (Hipp–TAU®, 1.303).

Table 8. Post hoc analysis of the analysis of pairs of variants with respect to Empathic Food Test questionnaire parameters (15 untrained observers).

	Difference	SE	*p*-Value
	Differences between TAU® and Holle		
I feel warm/cold	1.267	0.43	**0.023**
	Differences between TAU® and Hipp		
I feel warm/cold	1.533	0.43	**0.004**
	Differences between Bauck and Hipp		
I feel warm/cold	1.267	0.43	**0.023**

p-values in bold indicate statistical significance. SE: standard error.

The free description revealed differences in terms of the number of observations with positive connotations, the number of observations with negative connotations, and the cluster "relaxed" (Table 9). TAU® was rated more favorably than Holle and Hipp in regard to all three characteristics: number of positively connoted observations (TAU® mean 2.667, SD 1.05; Holle mean 0.467, SD 0.516; Hipp mean 1.40, SD 0.828); number of negatively connoted observations (TAU® mean 0.333, SD 0.488; Holle mean 1.0, SD 0.535; Hipp mean 1.0, SD 0.704); and cluster "relaxed" (TAU® mean 0.933, SD 0.594; Holle mean 0, SD 0; Hipp mean 0.467, SD 0.516). There were no significant contrasts between Bauck and Hipp, but there were between Bauck and Holle in terms of number of positively connoted observations (Bauck mean 1.733, SD 0.799; Holle mean 0.467, SD 0.516) and cluster "relaxed" (Bauck mean 0.733, SD 0.594; Holle mean 0, SD 0). Differences in terms of the number of positively connoted observations were identified between the pairs TAU® and Bauck, and Holle and Hipp. Holle and Hipp also deviated in the cluster "relaxed".

Table 9. Post hoc analysis of the analysis of pairs of variants with respect to Empathic Food Test free description observations (15 untrained observers).

	p-Value	Effect Size *r* [4]
	Differences between TAU® and Holle	
Total negative observations [1]	**0.001**	**0.69**
Total positive observations [2]	**<0.001**	**0.93**
Cluster "relaxed" [3]	**<0.001**	**0.83**
	Differences between TAU® and Hipp	
Total negative observations	**<0.001**	**0.71**
Total positive observations	**<0.001**	**0.77**
Cluster "relaxed"	**0.016**	**0.56**

Table 9. *Cont.*

	p-Value	Effect Size *r* [4]
Differences between Bauck and Holle		
Total positive observations	**<0.001**	**0.39**
Cluster "relaxed"	**<0.001**	**0.75**
Differences between Bauck and TAU®		
Total positive observations	**0.003**	**0.64**
Differences between Hipp and Holle		
Total positive observations	**<0.001**	**0.79**
Cluster "relaxed"	**0.005**	**0.62**

[1] Total of negatively connoted observations. [2] Total of positively connoted observations. [3] The cluster comprises the observations "relaxed", "well", and "calm". [4] Effect size *r*: <0.3, weak effect; >0.5, strong effect.

3.5. Chemical Analysis

The chemical analysis revealed only minor differences between the products (Table 10). Overall, acrylamide levels were low, with TAU® having the highest value. The effect of supplementation appeared to be evident in vitamin B1. The values for baby products were higher than the products without supplementation. The vitamin B9 content in TAU® was slightly lower compared to the other products.

Table 10. Chemical analysis of oat products.

		Holle	Hipp	Bauck	TAU®
Acrylamide	µg/kg	<10	11	<10	21
Total fat content	g/100 g	6.4	6.8	6.5	5.0
Saturated fatty acids	g/100 g	1.2	1.3	1.1	0.9
Monounsaturated fatty acids	g/100 g	2.6	2.7	2.7	2.0
Polyunsaturated fatty acids	g/100 g	2.6	2.9	2.7	2.1
Lysine	g/100 g	<0.01	<0.01	<0.01	0.01
Vitamin B1 (thiamine)	mg/100 g	1.05	1.36	0.310	0.171
Total folate (vitamin B9)	µg/100 g	22.5	24.2	20.4	12.1

4. Discussion

4.1. Infant Products Compared with Other Products

The two conventional infant food products from Hipp and Holle hardly differ, as seen in the descriptive analysis, the emotional profiling conducted by trained testers, and the consumer test. In the descriptive analysis, the two infant products by Hipp and Holle stood out above all others due to their significantly lower aroma and taste intensity compared to the products by TAU® and Bauck.

The two conventional baby food products by Hipp and Holle received a significantly lower score in emotional profiling by trained testers, especially in terms of emotional well-being (item relaxed—nervous; mean score—emotional) compared to the products by TAU® and Bauck. In the free description, more negatively connoted and fewer positive characteristics were observed overall.

In the hedonic consumer test only, the two conventional baby food products of Hipp and Holle (with the lighter flour) were preferred over the TAU® product regarding appearance. In the EP conducted by consumers, Hipp and Holle products were perceived as less warm, and positively connoted characteristics were observed much less frequently than with TAU® and Bauck products.

4.2. Flakes for Porridge Compared with Hydrothermally Processed Products

According to the NOVA classification for the degree of processing, flakes are considered minimally processed in the first stage, whereas baby food is classified as ultra-processed in the fourth stage [4]. Flakes could therefore serve as a reference for the more intensive processing of cereals. In fact, in the descriptive sensory analysis, the Bauck product clearly differed from conventional baby products; it had a more intense smell and taste and a higher score in the emotional profiling by trained observers than the baby food products. This was confirmed by the results of [26], who compared the processes of flaking, extrusion, popping, and traditional rolling for spelt and buckwheat. In the EP, the gentlest process, flaking, was rated the best.

The TAU® product, made from whole-grain oat flour, has been opened using its own enzyme activity with water and heat (hydrothermally) in a complex process (see [41]) and cannot be easily classified in the NOVA system. In the descriptive analysis, TAU® showed a different character than the flakes and the most distinct cereal notes. In the EP, TAU® was rated slightly more favorably than Bauck in tests with trained observers and in consumer tests, with the differences from conventional infant products being more pronounced in these tests.

4.3. Results of Trained and Untrained Observers

The trained observers who conducted sensory profiling found considerably greater differences between the products than the consumers. This result is supported by studies that compare sensory analyses by consumer panels with those by experts [4], [42–45], which found that trained experts were more precise in their analyses than consumers.

Working with trained panels is relatively new in EP; thus, there are few studies on the subject. Geier (2018) [30] compared groups of 60 consumers with no preparation, short preparation, and longer preparation in EFT using pairs of samples with similar sensory characteristics. A trained panel was also involved. The consumers who had been prepared for a longer period (4 h) came to similar conclusions to the expert panel, while the unprepared consumers rated all three sample pairs differently. This illustrates the influence of training on EP, as well, and is consistent with research findings on body perception. Klimecki et al. (2014) [46] showed that empathy and compassion can be learned. Interestingly, in the present study, consumers came to largely consistent results with those of trained panelists (see results of the free description); only clarity was lower for consumers than for panelists. The preparation time for consumers was only 50 min. One limitation of the consumer tests in the present study was the small number of participants (26 or 15), which did not meet the ISO requirements for hedonic sensory tests. Nevertheless, consumers were able to identify some significant product differences with a strong effect size.

4.4. Comparing Sensory and Emotional Profiling

Trained testers using sensory descriptive analysis and EP consistently rated the two baby products as a group and the other two products as independent. In consumer testing, the differences identified by EP were greater than those identified by sensory profiling. This confirms Prinyawiwatkul's (2023) [47] assessment that emotional profiles and ratings may effectively differentiate products with similar sensory characteristics and hedonic ratings. In studies by [16] on milk and [48] on honey, the trained panelists found more significant product differences through EP than through sensory profiling.

4.5. Differences in Chemical Composition

The TAU® product stands out due to its slightly higher acrylamide content and lower fat and vitamin content. There are no scientific studies available on the manufacturing process using hydrothermal breakdown that can confirm a connection between the process and the measurement results. The other products hardly differ. Only the infant products have higher vitamin B1 values, presumably as a result of fortification.

5. Conclusions

Sensory and emotional profiling revealed that intensively processed infant oat products can be clearly distinguished from less processed ones. The results were more distinct for trained observers. Among consumers, emotional profiling was more effective in product differentiation than sensory hedonic testing. Sensory and emotional profiling are suitable for describing differently processed oat products. The results of the study provide indications of how future experiments can better understand the relationships between processing, sensory, and emotional characteristics. Due to the small sample size, the generalizability of the results needs to be verified by further research.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/gastronomy4010006/s1, EFT questionnaire S1.

Author Contributions: Conceptualization, U.G.; methodology, U.G.; formal analysis, J.K. and G.M.; investigation, J.K. and G.M.; writing, U.G. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by ErdmannHAUSER Getreideprodukte GmbH and Demeter e.V. (AKBDF 2025).

Institutional Review Board Statement: This study involved a non-interventional sensory evaluation of oat products in which adult participants voluntarily tasted food products and provided feedback through anonymous questionnaires. In accordance with the funding guidelines of the German Research Foundation (Deutsche Forschungsgemeinschaft) of 17 July 2024, ethical review and approval were waived for this study, as no vulnerable groups are involved; no biological material was collected; the test subjects did not represent a vulnerable group; the test subjects were not exposed to physical risks, pain, stress, or strong emotions; the test subjects gave their written consent; and the data was treated anonymously.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The Empathic Food Test questionnaire is available in the Supplementary Materials. The data are unavailable due to a confidentiality commitment made to the study participants in the study.

Acknowledgments: We would like to thank the sensory laboratory of Döhler Sensory & Consumer Science for their excellent cooperation. We would also like to thank Demeter e.V. for their support. Generative artificial intelligence (GenAI) was not used in this paper.

Conflicts of Interest: The authors declare no conflict of interest. The study was partially funded by the manufacturer of the TAU® product. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Abbreviations

The following abbreviations are used in this manuscript:

EP	Emotional profiling
EFT	Empathic Food Test

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