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A consumer-oriented classification system for home meal replacements

A.I.A. Costa *, M. Dekker, R.R. Beumer, F.M. Rombouts, W.M.F. Jongen

Project design and Quality Management Group, Department of Agro-Technology and Food Sciences, Wageningen University, PO Box 8129, 6700 EV Wageningen, The Netherlands

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Abstract

This paper introduces a new definition and classification system for home meal replacements (HMR), based on convenience attributes as viewed by consumers. An overview of other food classifications, focusing on methodological aspects, is also presented. The classifying criteria chosen (shelf-life and required preparation) and their organisation in a 4×4 matrix structure demonstrated to provide a sound and effective way of classifying HMR. A qualitative analysis of HMR consumption in The Netherlands was performed by application of the developed system. Results showed that the use of a narrow range of HMR is characteristic of Dutch food consumption. The classification system is expected to provide valuable support for consumer-oriented product and process development.

Keywords: Home meal replacements; Classification; Convenience; Consumption; Product development

1. Introduction

Of the many trends assigned to today's 'Western' food consumer by marketers and manufacturers, 'lack of time' is certainly the one we can least argue against. For most of the active population there is not much time to eat and even less for shopping and cooking. According to Hollingsworth (1997), 60% of the American consumers do not know at 4 p.m. of a week day what they will do for dinner, but expect to loose only about 30 minutes with its preparation, cooking, eating and cleaning up. Moreover, 40% of Americans consider cooking at home a bother and meal preparation a highly time-consuming activity (Sloan, 1997). This trend has also been extensively reported in EU countries, along with increasingly shorter shopping cycles (Dade, 1992; Datamonitor, 1998; McHugh, Greenan, Kerrigan, & Wightman, 1991; Ritson & Hutchins, 1995).

However, and in spite of the generalised need for speed, consumers do not always seem ready to compromise the pleasure of eating a tasty meal for the sake of earning extra time. According to Sloan (1997), there are indeed situations in which American consumers willingly spend time preparing and eating meals, for instance on weekends or if they have guests. Therefore, eating remains a key part of leisure or socialising, as well as a valued personal experience (Datamonitor, 1998; Gofton, 1995; Marshall, 1995).

It is not surprising that there is a growing interest of all food chain partakers in supplying quality dishes or full meals that can quickly and conveniently replace home-made meals. The so-called 'meal solutions' bring more choice for the hurried consumer who still likes to eat a good meal, and thus a good business opportunity for food manufacturing, service and retail alike (Bond, 1992; Larson, 1998). In 1998, Datamonitor (1998) reported ready meals' (the manufactured share of meal solutions) sales of almost US$ 13.5 billion, for a total of eight Western European countries. In the meantime sales in North America were over US$ 12.5 billion. Until 2003 the ready meals' sales in Western Europe are expected to grow on average 3% in value and 2.5% in volume. Yet in countries like Italy and Spain a growth in sales value of as much as 7.5 and 14.5%, respectively, is expected. Attention must be paid, however, to the fact that only half of a North American family's food budget is currently spent on retail shopping, the other half being spent on foodservice. The search for meal solutions

* Corresponding author. Tel.: +31-317-482286; fax: +31-317-483669.

E-mail address: ana.costa@ift.fdsci.wag-ur.nl (A.I.A. Costa).

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in foodservice or *via* Internet ordering is rapidly spreading and should be taken very seriously by food manufacturers (Datamonitor, 1998).

There is an increasing diversity of production/distribution solutions offered to consumers with the aim of partially or fully replacing home-made meals (Fig. 1). Consequently, meal solutions terminology is also increasingly complex, and food chain partakers resort to their own (mostly obscure and vague) definitions and designations. Nevertheless, the introduction of technical jargon does not improve this situation. It is difficult to clearly differentiate meal solutions from each other (or from other foods) based on a specific level of technological or kitchen processing, since they can be as diverse as a chilled sandwich, a take-out meal, a frozen pizza, canned stew or a restaurant dinner. The apparently simple issue of defining what exactly a meal is appears already to be extremely intricate (Meiselmann, 2000).

More or less scientific tags for meal solutions, such as *ready-to-eat*, *sous-vide*, *oven-ready*, *cook-chill*, *refrigerated foods with extended durability*, *minimally processed* and *frozen TV-dinner* are not new to manufacturers or even to consumers (Brody, 1998; Ghazala, 1999; Mossel & Struijk, 1991; Notermans, Dufrenne, & Lund, 1990; Paulus, 1977; Verlegh & Candel, 1999). They are intended to reflect the various degrees of readiness for consumption and the preservation properties intrinsic to such foods, but this intention is not always perceptible to the consumer. Senior (55+ years old) Dutch citizens, for instance, have reported during focus group discussions that they have difficulties understanding exactly what 'ready-to-eat' means. Likewise, they have difficulties in relating advertised claims with the actual convenience levels provided by the food products (Costa, unpublished data).

It is not only the consumer or manufacturer who has difficulties in understanding exactly what lies under current Meal Solutions terminology. A direct result of this disarray is the difficulty of harmonising safety criteria for Meal Solutions (European Commission, 1998) or holding them accountable for food-borne illness incidents (Fraser, Sawyer, Andrews, Youatt, & Kirkwood, 1995). Public health systems in many countries do not have a specific food class or a classification system under which food-borne illness incidents related to ready-meals' consumption can be recorded, simply

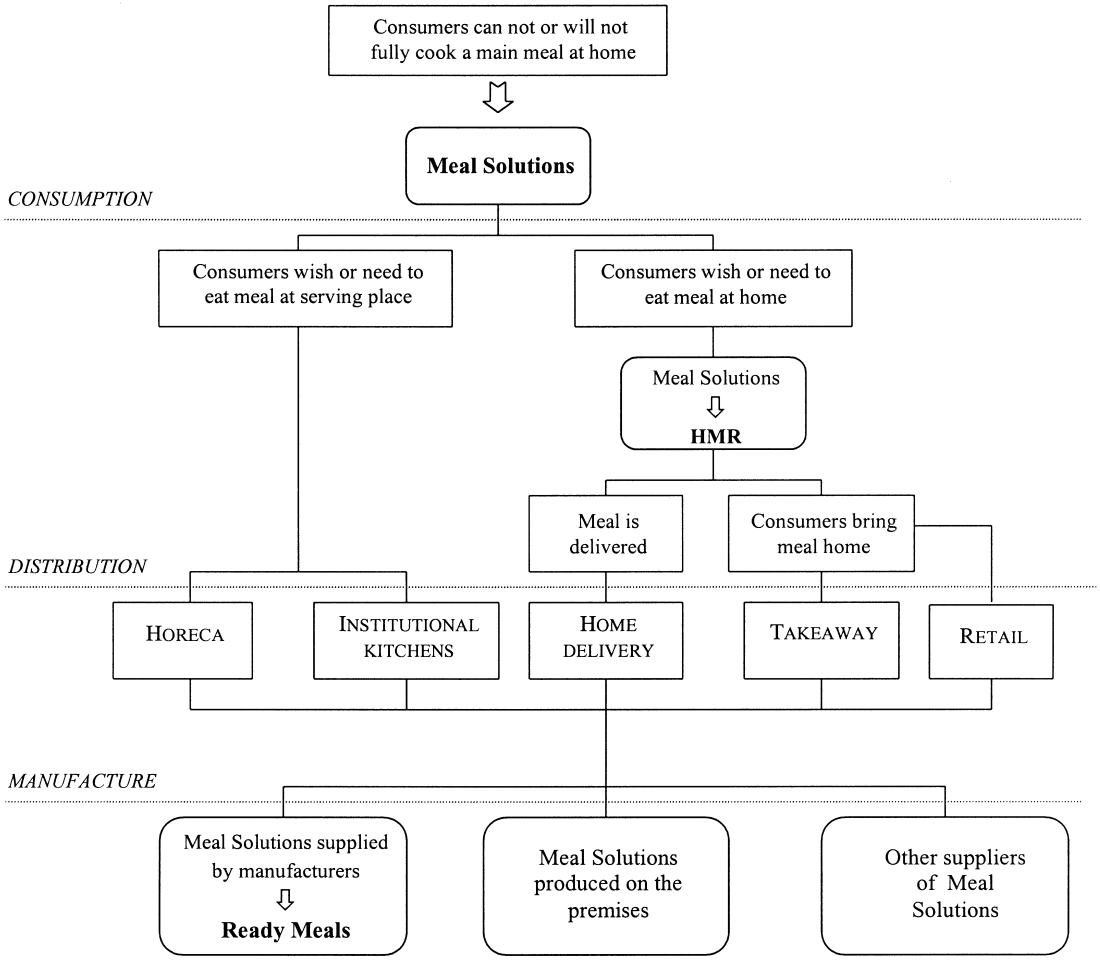

Fig. 1. The category of Meal Solutions and its terminology (HORECA: HOtels, REstaurants and CAtering).

because it is very difficult to define what a ready-meal is. Perhaps this might be one reason why chilled ready meals have consistently maintained excellent safety records despite the considerable body of evidence gathered demonstrating the high potential for hazardous mishandling. (Fraser et al., 1995; Hauben, 1999). Public health policy-makers and food scientists are therefore in need of unambiguous definitions and classifications for meal solutions. Additionally, product development and marketing teams involved in the food business can also greatly benefit from a clear product classification system (Larson, 1998; O'Carrol, 1998a, b).

The aim of this paper is therefore to extend our present knowledge of HMR by developing a consumer-oriented system for its classification. The paper starts by proposing a use-based, comprehensive and clear definition of home-meal replacements (HMR) as a sub-category of meal solutions. Next, an overview of current food classifications is presented, focusing on methodological aspects. Finally, a new classification system for HMR is presented, followed by validation and discussion of possible applications in food science.

2. What are home meal replacements?

Home meal replacements are meal solutions that have been produced away from home for in-house consumption (Fig. 1). According to our understanding they are defined as:

> Main courses or pre-assembled main course components of a meal — a protein (animal or plant), a carbohydrate (starch) and a vegetable source — , in single or multiple portion containers, designed to fully and speedily replace, at home, the main course of a home-made main meal.

Therefore, main course components packed in non-assembled, separate containers as well as all kinds of desserts, breakfast cereals, yoghurts, candy bars, etc. are excluded from this definition. Some snacks (foods usually eaten in-between main meals), starters, soups or salads can be considered as HMR as long as they respect the readiness and compositional requisites set by the definition and can be regarded by consumers as a meal's main dish.

The proposed definition intends to clarify previous HMR characterisations (Datamonitor, 1998; Ghazala, 1999; Larson, 1998; Morris, 1998; O'Carrol, 1998b; Solganik, 1997) by focusing on use-based requisites such as readiness, pre-assembly and main ingredients for sub-category delineation. Furthermore, it makes no distinction between technological sectors or distribution channels, and thus reflects the current market integration movements (both horizontal and vertical) within the food chain business (Ghazala, 1999).

3. How can we classify HMR

3.1. Classification systems

> The world consists of an infinite number of potentially different stimuli. Thus a basic task of all organisms...is a segmentation of the environment into classifications by means of which non-identical stimuli can be treated as equivalent (Rosch, 1978).

Classifications group items under pre-defined criteria by emphasising similarities or differences between them and providing a commonly accepted range of item designations (Axelson & Brinberg, 1989; Peri, 1990). Methodologically speaking, they should be based on precise definitions and clear criteria. Moreover, they should provide a hierarchical ranking of the items under classification and exempt from ambiguities. Finally, classifications should be comprehensive, yet concise (Lennernas & Andersson, 1999; Peri, 1990). As any other simplified representation of reality, classification systems should be validated and tested for reproducibility and usability.

3.2. Food classification systems

Consumers instinctively categorise foods because this process provides them with an orderly system by which to view and structure the available food supply (Axelson & Brinberg, 1989; Rosch, 1978). By identifying and placing foods in classes, they make associations between a product and a group with which it shares a set of characteristics, benefits or harms. This in turn influences consumers' food-related behaviour, not only with respect to post-acquisition conducts (storing, handling, preparing and serving foods) and actual consumption, but also with respect to food perception and choice (Axelson & Brinberg, 1989; Johnson, 1974; Schutz, Rucker & Russel, 1975). On the other hand, classification systems are also relevant in organising and communicating information within different areas of food science, like nutrition, marketing, unit operations and microbiology.

Regarding their methodological approach, existing food classification systems can be divided into four main groups:

1. Classifications elicited from a list of items;
2. Classifications elicited from behavioural observations or consumer data;
3. Classifications deduced using pre-defined convenience criteria;
4. Classifications that share two or more of the previous approaches.

3.2.1. Technological food classifications

Commonly food classification systems are based on extensive lists of food items grouped according to pro-

cessing technologies, fermented, frozen, canned, etc., and/or major raw material's origin, dairy, seafood, cereals, etc. These so-called 'technological classifications' usually form the skeleton of assortment catalogues, nutritional surveys, sales and consumption data collections, international safety guidelines and other technical or scientific publications (Datamonitor, 1998; European Commission, 1998; Fraser et al., 1995; Stannard, 1997; Voedingscentrum, 1999).

Among technological food classifications the most widely known are perhaps those related to nutrition and diet. Their aim is to contribute to the improvement of the diet and health of the population by communicating nutritional guidelines in a simple manner. The food pyramids or food wheels, for example, illustrate the structuring of foods into groups based on their function in the meal system and their major contribution to the diet's nutritional value. (Axelson & Brinberg, 1989; Johnson, 1974; Peri, 1990; Schutz et al., 1975). Food-based classifications are also used to characterise and assess dietary patterns and eating episodes (Lennernas & Andersson, 1999; Popkin, Haines, & Siega Riz, 1999). The area of food processing has also found use for technological classifications, namely in the provision of standards for processes and products (Barbiroli & Mazzaracchio, 1994) or the improvement of operations' efficiency and effectiveness (Erzincanli & Sharp, 1997; Peri, 1990). Regarding food preservation and microbiology, food classifications are mainly used in microbiological quality control (Gravani, 1986; Mannheim, Liu, & Gilbert, 1994), hazard analysis (Lee & Hilderbrand, 1992), public health and risk analysis tasks (Fraser et al., 1995), standardisation (Stannard, 1997) and safety guidelines (European Commission, 1998).

Classification systems lay at the core of food market research by conferring structure to production, sales, purchase and consumption data reports (Datamonitor, 1998; Euromonitor, 1996; Mintel, 1996; Voedingscentrum, 1999). Still within the marketing area, category definition and sub-category product segmentation are essential for key processes in the food retail category management, such as assortment management or new product introduction. Furthermore, classifications can help uncover food companies' lack of technological and/or marketing consistency by highlighting product categories that are not being (well) addressed by their production or marketing activities. Hence, they can be used as indirect performance measures of R&D teams' technological and marketing competence, while providing helpful guidance in product innovation in its broadest sense (Geraedts & Berg, 1999; Peri, 1990).

Nevertheless, conventional (technology-based) food classification systems present conceptual frailties. Since they are simply elicited from more or less comprehensive item lists, they often lack coherence and clear definition. Classes are either too general, in order to avoid overlapping or ambiguity when classifying new products with existing systems, or too detailed, in order to fit in the extensive amount of new product and process developments in the food area. Overall, technological food classifications are unable to maintain the necessary balance between detail and comprehension (Johnson, 1974; Peri, 1990). Moreover, they are rarely tested to check their ability to classify, precisely and completely, the range of products they intend to. Thus, they generally lack scientific proof of their validity.

Last but not least, technological food classifications have been designed to meet the classifiers' particular needs, rather than to reproduce the way consumers themselves would make the groupings (Schutz et al., 1975). In addition, testing of whether or not established food classifications reflect consumer's own groupings is very scarce (Axelson, Kurinij, & Brinberg, 1986). An exception is provided by the study of Axelson et al. (1986), who tested whether food groups displayed by nutrition guides reflected consumers' own food classifications. The results obtained show that (1) consumers may use other than product-related criteria to group foods and (2) consumers' classifications are probably more complex than the ones structuring nutrition guides. Thus, all existing evidence seems to indicate that technological food classifications do not adequately reflect the consumer's perceptions of food and its uses (Axelson & Brinberg, 1989; Johnson, 1974; Schutz et al., 1975). This makes them of limited value for consumer-oriented product development and marketing.

Moreover, given current product diversity and the rate of product introduction, consumers experience difficulties in using the conventional groups to identify and classify foods, difficulties that are increased by the general decline of cooking and household skills (Datamonitor, 1998; Johnson, 1974; Larson, 1998). This situation may be rendering nutrition and safety communication by health-officials rather inefficient, since consumers depend on correct product identification and characterisation to make decisions about their diet choice and food handling. (Axelson & Brinberg, 1989; Axelson et al., 1986; Brody, 1998; Creed & Reeve, 1999; Johnson, 1974).

3.2.2. Food classifications and behavioural studies

Classification systems can also be used to study food consumption from a behavioural perspective. Examples of such studies are the anthropological or sociological classifications and the food-use classifications. Jelliffe (1967) developed a 'world-wide' food classification by comparing eating patterns in developing and industrialised countries, while Schaik (1964) and Leininger (1969) used observational studies to group food's sociological uses. Food-use knowledge has also been employed by market researchers to segment product supply, leading to 'recipe-based' classifications (Mintel,

1996; Table 1). However, since these studies are based only on the researchers' own perception of consumer behaviour and were not further validated, the resulting classifications may not have much correspondence to the actual consumer behaviour (Axelson & Brinberg, 1989; Schutz et al.,1975).

Other use-based food classifications have been derived directly from consumer data. Fewster, Bostian and Powers (1973) used consumer data to generate 12 major categories of connotative meanings associated with food and food habits, mostly based on preference ratings. From these categories, 25 scales for measuring food meanings were developed and validated. Axelson et al. (1986) asked 51 college students to group 23 foods representing the nutrition guides' Four Food Groups according to their own criteria. The students grouped the foods in a manner related to but more complex than the Four Food Groups. The criteria apparently used to make the groupings were convenience in preparation, health-related properties and the food source (animal or plant). Yet, the study did not proceed to establish a classification system (with defined classes within each criterion) that could display the results obtained in a structured manner. In a study conducted by Schutz et al. (1975), consumers judged the appropriateness of allocating certain food items to pre-defined use categories. However, these use categories had not been tested for validity and reproducibility prior to the study.

Consumers tend to classify foods based on their own preferences and evaluations rather than on more objective criteria (Axelson et al., 1986; Schutz et al., 1975; Worsley, 1980). Thus, classifications related with food consumption behaviour, even when originated in direct consumer data and fully validated, tend to be extensive and systematically lack any kind of hierarchical structure or defined criteria (Schutz et al., 1975). While they can provide useful information regarding consumer behaviour, which can be employed in marketing activities, these type of categorisations are often difficult to translate into specific, quantitative product features. This renders them of limited value for product development.

3.2.3. Convenience-based food classifications

Convenience attributes in food supplies are highly valued by the foodservice industry since they contribute to a more efficient resource employment in the food preparation process. Advantages brought by the use of convenient food supplies are: time, labour and bulk reductions in acquisition and logistic activities; downsizing of kitchen inputs such as time, skills, energy, labour and equipment; pre-assembly; ease of storage and regeneration (bringing stored foods to a state of readiness for consumption), and storage extension. However, foodservice entrepreneurs lacked a user-based, coherent and precise system to identify and group food supplies with regard to their different levels of built-in convenience (Harrison, 1979; Paulus, 1977; Pepper, 1980; Sheard, 1999). Subsequently, several food classification systems based on pre-defined attributes of convenience have been developed by and for the foodservice industry. Harrison (1979) has developed a convenience scale to rate caterers' food supplies on the basis of their pre-assembly and readiness for service levels (Table 2). Paulus (1977) suggested a classification system based on the processing stage prior to arrival in an institutional kitchen, in which provisions could be categorised as *Ready to cook*, *Ready to heat*, *Ready to kitchen process* or *Ready to eat*. Having in mind the fast food sector, Pepper (1980) classified supplies in terms of the preparation level required before servicing: *No Preparation*, *Mixing*, *Heating*, *Mixing/Cooking* and *Cooking*. This study also pointed out the close relationship existing between food preparation methods and preservation/storage methods (Fig. 2). None of these studies were, however, validated.

Table 1
Worldwide, food use and recipe-based classification systems (Jelliffe, 1967; Leininger, 1969, Mintel, 1996; Schaik, 1964)

Classification system	Classes	
World-wide	Cultural super-foods (staple commodity and major calorie source); Prestige foods (for important occasions and community leaders); Body-image foods (fitting cultural ideas regarding body functions); Sympathetic magic foods (associated with beliefs in food properties); Physiologic food groups (reserved or forbidden to women or elderly)	
Food use	*Social uses*	*Physiological uses*
	Means of family contact	Provide energy
	Recreation and enjoyment	Satisfy hunger
	Initiate/maintain interpersonal relations	
	Help cope with psychological stress	
	Educational uses	*Status functions*
	Express religious ideas	Influence a group's political status
	Reward or punish	Bring prestige
	Treat or prevent behaviour deviations	
Recipe-based	Traditional British meals (chicken roast, sausage and chips); International and gourmet meals (curries, stroganoff, Italian pasta); Fish-based meals (fish-in-sauce recipes, fish pies); Niche meals (vegetarian, 'fixed calories', 'authentic ethnic')	

On the other hand, convenience attributes are also relevant for the household food preparation process. They are a decisive factor in food choice and major trends in consumer demand (Datamonitor, 1998; Gofton, 1995; Rappoport, Peters, Huff-Corzine, & Downey, 1992). In line with the approach used in the food service industry some studies used household-based convenience attributes to develop definitions and classification systems. According to Traub and Odland (1979) "the term convenience foods refers to fully or partially prepared foods in which a significant amount of preparation time, culinary skills or energy inputs have been transferred from the home kitchen to the food processor and distribution". Based on a similar convenience concept Havlicek, Axelson, Capps, Pearson, and Richardson (1983) created a four-category system for all foods used in the household. Categories considered were *Non-Convenience* (fresh and home processed foods or ingredients with no home-prepared counterpart), *Basic Convenience* (single ingredient processed items), *Complex Convenience* (foods with high levels of timesaving and culinary skills built in and multi-ingredient prepared mixtures) and *Manufactured Convenience* (foods with no home-prepared counterpart).

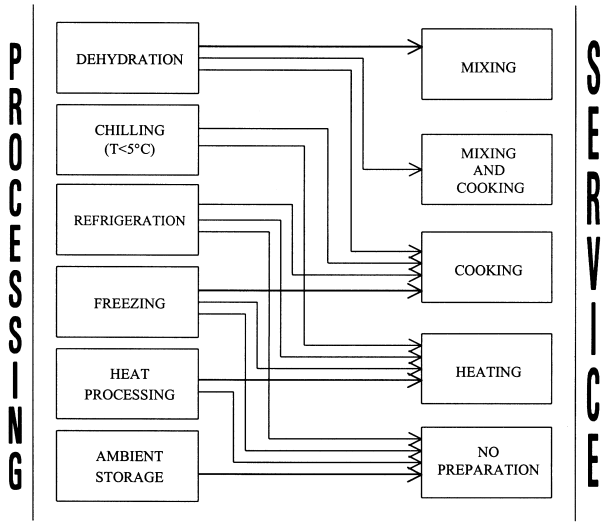

Fig. 2. Relationship between food preservation/storage methods and preparation levels required before servicing (Pepper, 1980).

Perhaps fairly more comprehensible and meaningful than to view the consumer's kitchen as a 'household-based preparation unit' or his/her food shopping as 'process inputs', is to relate convenience levels with the amount of preparation foods require before they can be eaten (Pepper, 1980). Therefore Pearson, Capps, Gassman, and Axelson (1985) grouped the 4082 food products recorded in the 1977–1978 USDA Nation-wide Food Consumption Survey database in a 14-category system, according to the household preparation activities they required. Due to its excessive length, the system was then condensed into three major food preparation categories — *No Preparation, Some Preparation* and *Considerable Preparation*. Another classification criterion — the extent of processing prior to arrival at the home kitchen — was brought into the system to compensate for the subsequent loss of resolution. In it, two classes — *Non-convenience* and *Convenience* (basic, complex or manufactured) — were created, in an abbreviation of the above-mentioned classification of Havlicek et al. (1983). The final system was therefore a three by two 'preparation required by built-in convenience' matrix (Fig. 3). Both the 14-category system and the final matrix were validated using the set of foods from which the system had been extracted (the survey's database). Food technologists, home economists and nutrition students tested the 14-category system's usability with a sub-set of 82 food products. The survey's quantitative results (food product consumption per household) were grouped according to these 14 categories, enabling the authors to assess both the quality and quantity of household food consumption per level of preparation required (Pearson et al., 1985). The advantages of this approach for food classification are the consumer relevance of the chosen criteria and the development of a systematic validation procedure for classification systems. Its main weakness is that the authors did not resort to pre-defined criteria or classes to build their system but rather elicited it directly from a set of food products. Moreover, the

Table 2
Convenience scale for food supplies (Harrison, 1979)

Convenience scale	Description
Zero convenience	The completely fresh produce; the unprocessed product where the requirement for peeling, paring, maturing, cleaning, basic preparation, and other basic stages have to be done.
Basic convenience	Where basic stages as described have been completed but where slicing, shredding, mincing, soaking, dicing, chopping, rolling, shaping, etc. have to be carried out.
Pre-assembly convenience	Where items mentioned above have been carried out but the aspect of assembly is missing: constituents are available in an easy to handle format but need to be combined.
Pre-cooking convenience	Where the items or principal constituents are assembled prior to cooking.
Pre-service convenience	Where items have minimal processing prior to service and where only defrosting or/and end-cooking or similar activities are required before service.
Full service convenience	Where items are ready to serve, when nothing more than opening a can or a box is required.

combined use of two convenience criteria, which are to some extent complementary, brought redundancy to the classification matrix. For some foods the fact that they have been partially processed reduces the level of preparation required before consumption. Thus, one of the two classification criteria chosen was sufficient to place foods in a defined convenience level. Finally, both the 14-category system and the classification matrix were tested resorting to the same set of products from which they had been extracted, therefore their validity was not established. The systems' reproducibility was also not tested.

4. Development and validation of a consumer-oreinted classification system for HMR

4.1. Development of the classification system

In view of the HMR definition presented, the characteristics of HMR products and the food classification studies reviewed, several conceptual and methodological requisites were taken into account in the definition of a HMR classification system. From a conceptual viewpoint, the classification system should be based on criteria that are relevant for both consumers and producers/providers when defining and grouping existing products. It should provide clear designations and a meaningful group structure for HMR assortments. Ideally the classification should reflect how consumers perceive the different HMR products, yet provide a direct link between the classes and specific technological sectors. This would demonstrate the usefulness of food classification systems as strategic tools for food product and process innovation, and related marketing activities (Peri, 1990).

From the many product attributes used by consumers as choice criteria for home meal replacements, like 'product range', 'quality consistency', 'main ingredients' or 'similarity to home-made', convenience attributes are usually at the top of the list (Dade, 1992; Datamonitor, 1998; Rappoport et al., 1992; Ritson et al., 1995; Sheard, 1999). Moreover, a study performed by Axelson et al. (1986) has indicated that consumers use convenience in preparation as a criterion to group foods. On the other hand, convenience attributes are relevant as user-based criteria for food classification, while also having direct counterparts in technological processes (Section 3.2.3). Therefore, it should be possible to build a sound, consumer-oriented HMR classification, in which classes are directly linked to technological processes, using convenience attributes.

From the methodological viewpoint, the classification system should be founded on pre-defined and precise classification criteria and not elicited from a product list or behavioural data. These criteria should be in sufficient number to comprehensively and concisely classify all HMR products currently available for consumption without any ambiguities. If more than one criterion is to be used, a reasonable degree of independence between criteria must be retained in order to avoid redundancy. Finally, the HMR classification system should be validated and tested for reproducibility and usability.

Based on the requisites listed above and on the reviewed literature, two convenience attributes were chosen as classifying criteria for home meal replacements — the level of preparation required before consumption (Cn) and shelf-life (Sn). Within the level of

	NON CONVENIENCE	CONVENIENCE
NO PREPARATION Eat as is Ready to use		
SOME PREPARATION Cut, slice and shell Thaw Hydrate Ready to heat Thaw then heat Hydrate then heat Ready to cook Thaw then cook Hydrate then cook		
CONSIDERABLE PREPARATION Cut, peel or shape then cook Add other ingredients, then cook Eviscerate, prepare for cooking, then cook		

Fig. 3. Preparation required by built-in convenience matrix (Pearson et al., 1985).

preparation criterion, and based on the range of preparation activities displayed by commercialised HMR products, four classes (C1–C4) were defined (Table 3). This definition explicitly encompasses the HMR regeneration process — the time/temperature couple required for bringing a HMR to a state of readiness for consumption-, which is 'translated' into the consumer preparation instructions displayed in the products' package. Additionally, it implicitly includes storage and preservation methods, since relationships between these methods and the levels of required preparation described by the classes can be established (Fig. 2). From C1 to C4, classes have an increasing level of time, appliances and energy inputs required before consumption. The level of culinary skills necessary for the preparation of the different HMR could not be regarded as a classificatory criterion, since it is characteristic of these products that their preparation requires only a likewise minimal level of those skills. For HMR belonging to class C4, however, higher cooking expertise or the addition of other ingredients may be required, as a consequence of how the C-classes have been defined. Other aspects of convenience such as reduced time and effort in purchasing and logistic activities, the meaning of 'convenience' for different groups of consumers or customers or the situational context in which meals are taken, were not considered. The pre-assembly aspect was already contemplated in the HMR definition presented.

The shelf-life criterion encompasses the convenience aspect of storage extension. For this purpose 'shelf-life' was defined as the period within which an HMR can be kept by the consumer at home, under the recommended storage conditions, without it being rendered unfit for consumption. Taking into account the shelf-life range displayed by commercialised HMR products, four shelf-life classes were chosen:

1. S1 $<$ 1.5 weeks
2. 1.5 weeks $\leqslant$ S2 $<$ 1.5 months
3. 1.5 months $\leqslant$ S3 $<$ 1.5 years
4. S4 $\geqslant$ 1.5 years.

The two pre-defined criteria — the level of preparation required before consumption (Cn) and shelf-life (Sn) — were assumed to be reasonably independent. They could consequently be arranged in a four by four 'shelf-life by preparation required' matrix structure, extending the number of possible classes from eight (the 4+4 granted by a separate criteria use) to 16. This improved considerably the level of detail of the classification without having to increase the number of classificatory criteria or define sub-classes. The matrix system developed is expected to classify all products defined as HMR without ambiguities, providing a clear and meaningful structure for this product category.

4.2. Validation of the classification system

A procedure similar to the one presented by Pearson et al. (1985) was followed in order to assess the validity of the proposed classification. In the first step of this procedure we have resorted to the Dutch National Food Consumption Survey 1997–1998 (DNFCS) database to obtain an HMR product list. The DNFCS database records the types of food consumed by a representative

Table 3
Four convenience classes for an HMR classification system

Convenience class	Description	Examples of commercialised products
Ready to eat (C1)	HMR consumed as purchased, requiring no prior preparation	Chilled sandwiches and salads, chilled pies, canned salads, take-away main courses and snacks
Ready to heat (C2)	HMR requiring only mild heating[a] before consumption (includes products processed up to a stage rendering them fit for immediate consumption after thawing or warm water addition)	Chilled pizzas and other main courses, frozen pizzas, frozen main courses and snacks or soups, dehydrated soups and spaghetti dishes, canned soups and main courses.
Ready to end-cook (C3)	HMR requiring sufficient heating[b] to finalise cooking before consumption.	Chilled and frozen lasagne, some frozen menus, dehydrated pasta dishes.
Ready to cook (C4)	HMR that have been minimally prepared for cooking (trimmed, shelled, peeled, cut, washed, etc.) but still require full cooking of some or all of its components.	Frozen seafood paella, raw chilled meat or fish cuts with side dishes, raw frozen fish cut with breadcrumbs and vegetable sauce.

[a] $\leqslant$15 min in a pan, or $\leqslant$20 min in a conventional oven/*au bain marie*, or $\leqslant$10 min in a microwave oven.
[b] $>$15 min in a pan, or $>$ 20 min in a conventional oven/*au bain marie*, or $>$10 minutes in a microwave oven.

Table 4
HMR classification system displaying the 174 HMR products' allocation and the percentage of products per class combination

	C1 (Ready to eat)	C2 (Ready to heat)	C3 (Ready to end-cook)	C4 (Ready to cook)
S1 (Shelf-life $<$ 1.5 weeks)	32 (18%)	2 (1%)	0	0
S2 (1.5 weeks $\leqslant$ shelf-life $<$1.5 months)	11 (6%)	11 (6%)	3 (2%)	0
S3 (1.5 months $\leqslant$ shelf-life $<$ 1.5 years)	2 (1%)	55 (32%)	14 (8%)	0
S4 (Shelf-life $\geqslant$ 1.5 years)	0	41 (24%)	3 (2%)	0

sample of the Dutch population during the surveyed period, and contains about 3100 items. More specifically, it records all the foods reported to have been eaten, either at home or outside, at least once by one of the respondents during the survey — 2-day food consumption diary method (Voedingscentrum, 1999). It does not contain, however, any information regarding the quantities of each recorded food product that have been consumed during the survey.

From the DNFCS database, and with the help of a Dutch dietician, all food products complying with the given HMR definition (174 items) were selected. Foods were only selected as HMR if they could be regarded as main courses of a household meal, which had been produced outside of the household. The decision of whether a food product could be considered a main course of a household meal was based on: (1) whether the food product complied with the compositional requisites present in the HMR definition; (2) our knowledge about HMR products currently commercialised in The Netherlands; and (3) our knowledge of the characteristics of Dutch food consumption and meal structure. The DNFCS database provided the necessary information regarding the provenance of the food product and the place of consumption. Next, information about shelf-life and required preparation for each of the 174 items was collected directly from the packaging of products displayed in supermarkets. In this way the information level was the same as that available to consumers. HMR products that could only be bought at a foodservice outlet and are intended for immediate consumption were given the shelf-life of 1 day. It was assumed that they do not require any further preparation before consumption. Finally, each item was classified according to the predefined criteria (Appendix A), and assigned to its respective C×S class combination within the matrix system.

The validation procedure followed implied the allocation of HMR products selected from the DNFCS database to the classification system. Hence, we were able to, based on the methodology developed by Pearson et al. (1985), directly apply the developed classification as framework in a convenience-based qualitative analysis of Dutch HMR consumption. In order to facilitate this analysis, the number of HMR products allocated to each class combination during the validation was calculated in a percentage form. The results of this qualitative analysis performed can be seen in Table 4.

5. Results and discussion

5.1. Validation of the classification system

The convenience criteria chosen and its organisation in a matrix structure demonstrated to provide a sound and effective classification system for home meal replacements. The proposed system enabled the classification of all HMR products selected from the DNFCS database without any ambiguities, demonstrating its validity for the given product list. However, results in Table 4 show that there were no products allocated to two class combinations (S4×C1, S1×C3) or to preparation level C4, which means that their specific validity could not be tested with the given product list. Thus, we can prove neither their validity nor their non-validity. Nevertheless, we have decided to assume these class combinations and C4 as valid until rebutting evidence is presented.

Our decision was based on three different aspects. First, there are HMR products currently commercialised in The Netherlands and elsewhere (Table 3) that are not present in the DNFCS database (due to the survey's nature and time span), but which could be allocated to the referred class combinations or to C4 level. For instance, canned tuna salad is a S4×C1 HMR product currently commercialised in Portugal and in The Netherlands. Thus, we have reason to believe that the validity of these class combinations and C4 level will be demonstrated when the system is tested with other product lists. Second, all convenience-based food classifications developed so far (see Section 3.2.3) include some measure of either the food's level of readiness for consumption or, complementary, the preparation level it requires before consumption. In all of them, likewise, this measure ranges from a 'ready-to-eat'/'no preparation required' convenience level to a 'ready-to-cook'/'considerable preparation required' one. Therefore, and from the supplier's perspective, the defined 'preparation required' criterion and its C1–C4 class structure make perfect sense. On the other hand, evidence also exists that some consumer groups, for instance the elderly, enjoy playing at least a small part in preparing their meals since this gives them the feelings of self-reliance and having more control over what they eat (Costa, unpublished data; Larson, 1998; Solganik, 1997). All the evidence put together shows that level C4 implies a

degree of convenience in meals that is both relevant from the suppliers' and the consumers' perspective, and thus should be maintained in the classification.

The third aspect concerns our trust that the proposed system reflects, at least partially, the way consumers classify HMR and perceive convenience in such products, that in turn influencing their product choice. In that context, classes to which no HMR products currently consumed can be allocated should not be immediately dismissed, since this may indicate a gap in how product assortments are meeting consumer demand. This information can be used to guide new product and process development. However, repeatability tests must first confirm that there is indeed a true gap between demand and supply, rather than an artefact caused by the nature of the product list used or by the system's definition. Moreover, the trust on the consumer-orientation of the classification must also be verified.

Overall, in order to trust the proposed HMR classification as a market analysis instrument, its usability, reproducibility and consumer-orientation still have to be established. Consumers, food scientists and food marketers (at academic and company level) are currently assessing the classification's usability and clarity. Regarding reproducibility, we are currently looking in The Netherlands and abroad for databases similar to the one we have used in the validation procedure. This will allow us to obtain product lists that are equally representative in terms of the actual HMR consumption. The issue of the classification's consumer-orientation will also be addressed in future work. According to the methodology developed by Axelson et al. (1986), we will check whether consumers would use similar convenience-related criteria to classify HMR products. Results of the usability, reproducibility and consumer-orientation testing will be reported in the near future.

5.2. Convenience-based qualitative analysis of Dutch HMR consumption

The qualitative analysis of Dutch HMR consumption yielded some interesting results. First, the fact that only 174 out of the 3100 survey items could be selected as HMR indicates that the use of a narrow range of HMR is characteristic of Dutch food consumption. It is not likely that this result was unduly influenced by the nature of the HMR definition used or by the validation procedure. The proposed definition is rather broad and the check for product compliance with it was quite thorough. Second, the analysis revealed the concentration of HMR consumption at two convenience levels: top convenience products with minimum shelf-life (S1×C1), mainly sandwiches and prepared meals supplied by foodservice, and long durability convenient meals (S3×C2/S4×C2), mostly frozen or canned ethnic meals (Table 4).

There are three possible explanations for the second result obtained. The first hypothesis is that it is an artefact caused by the proposed HMR classification. This hypothesis can only be dismissed once the classification's validity with other product lists (repeatability testing) has been verified. The second hypothesis is that the concentration of Dutch HMR consumption is an artefact caused by the data sample used — the DNFCS qualitative results. This is highly unlikely since the survey was carefully designed to provide a representative picture of Dutch nation-wide food consumption in the years of 1997–1998 (Voedingscentrum, 1999). However, we can not completely dismiss this hypothesis since no similar surveys were performed at the time with other representative samples of the Dutch population so that the results could be compared. The last, and most likely, hypothesis is that indeed Dutch HMR consumption in 1997–1998 was (and probably still is today) practically limited to products belonging to the two referred convenience levels, although products displaying different convenience levels were available. This hypothesis is partially corroborated by ready meals' sales for The Netherlands in 1997–1998, in which canned and frozen ready meals together represented over 70% of the total sales volume (Datamonitor, 1998). This situation can be either due to the nature of Dutch consumer preferences or to the characteristics of the HMR assortment available. How much each of these causes actually contributes to such concentration in HMR consumption and ready meals' sales is a topic worthy of further investigation. Nevertheless, it should be mentioned that forecasts for the next 3 years indicate that while frozen meals will still represent half of total ready meals' sales, chilled meals will gradually surpass their canned counterparts as the second most sold ready meals in The Netherlands (Datamonitor, 1998).

It may also be worth while to study the hypothesis of developing a similar classification for non-assembled main course components, which were not abridged by our HMR definition. Recent market reports indicate that the consumer demand for this specific type of convenience products is growing rapidly (Datamonitor, 1998; Ghazala, 1999, Solganik, 1997).

An analysis of the DNFCS quantitative results (food product consumption/household) is currently being performed in order to determine the weight of HMR consumption within Dutch food consumption. Existing relationships between HMR consumption patterns, consumers' socio-demographic characteristics and convenience levels of HMR products will be investigated using the proposed classification, as suggested by the work of Pearson et al. (1985). This investigation is expected to uncover areas where the introduction of new products and/or new marketing strategies could bring great benefit.

6. Final remarks

It seems that the HMR classification proposed might be useful in establishing relationships between product attributes and the consequent benefits as perceived by the consumer, and personal values. If this proves to be the case, it would be interesting to use the classification to study how consumers perceive different convenience levels and how this perception, in turn, influences their food choice. Other topics in this area that could also be investigated are: (1) the situation's influence on convenience perception and HMR consumption (Verlegh et al., 1999); (2) HMR acceptability (Ghazala, 1999); and (3) consumer trade-off mechanisms between health, taste and convenience (Rappoport et al., 1992).

Supported on Pepper's (1980) findings, the existent relationships between the convenience-related classes of the proposed system and the different technological sectors involved in HMR production will be further examined. The usability test is expected to show whether or not the development of a more detailed system is necessary in order to obtain clearer relations between classes and enabling technologies. Such development may involve the definition of sub-classes within the established classes. For instance, in class C2 (Table 4) a sub-category for products that are ready for consumption after thawing or re-hydration could be created.

This paper has presented a clear definition and a new, valid classification system for home meal replacements. It is proposed that this system can play an important role in linking consumer perceptions, product attributes and enabling technologies, helping to streamline food product development. The qualitative analysis of the Dutch HMR consumption in 1997–1998 performed through the use of the proposed classification highlighted a mismatch between the diversity of convenience levels inherent to current HMR offer and the narrowness of those inherent to the products actually consumed. We think that this analysis sufficiently demonstrates that such a classification system can provide valuable guidance for more consumer-oriented food product development and marketing activities.

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Appendix on next page.

Appendix A. HMR products' description and classification: designation, main components, preservation method, shelf-life and preparation instructions

Designation	Main components	Preservation method	Shelf life	Preparation	Classification	
Bami Goreng	Beef/pasta/soy bean sprouts	Cooked	1 day	None	S1	C1
Hamburger	Beef/bread/onion/gherkin	Cooked	1 day	None	S1	C1
Chicken curry salad	Chicken/potatoes/celery	Refrigerated	23 days	None	S2	C1
Potatoes with bacon	Bacon/potatoes/onion	Refrigerated	1 month	Heat in a pan with oil or butter for 10–12 min	S2	C2
Pizza Tre Fromaggi	Cheese/pizzabase/tomato	Frozen	6 months	Heat for 12–14 min in a conventional oven	S3	C2
Spaghetti Carbonara	Cheese/bacon/pasta/broccoli	Dehydrated	12 months	Add to boiling water and cook for 10–15 min	S3	C2
Pea soup	Sausage/potatoes/peas	Frozen	6 months	Cooking in a pan for 15 min with added water	S3	C2
Egg roll	Chicken/dough/sprouts/leak	Frozen	8 months	Fry in oil for 25 min	S3	C3
Brie Sandwich	Cheese/bread/lettuce	Refrigerated	1 day	None	S1	C1
Dutch potato dish	Ham/potatoes/mushrooms	Frozen	6 months	Heat in a pan with oil for 10–15 minutes	S3	C2
Pea soup	Sausage/potatoes/peas/onion	Sterilised in a can	2 years	Heat in a pan for 5 min	S4	C2
French meat dish	Beef/potatoes/peas Carrots /mushrooms	Frozen	6 months	Heat with a pan for 8 min in a small quantity of water or in a microwave oven for 10 min	S3	C2
Macaroni Ham/Cheese	Ham/cheese Pasta/tomato/peppers	Sterilised in a can	2 years	Heat for 2 minutes in a pan or microwave oven, or for 10–15 min *au bain marie*	S4	C2
Lasagne Bolognese Verdi	Ham/cheese Pasta/spinach/tomato	Refrigerated	14 days	Heat for 12 min in a microwave oven, for 25 min in a conventional oven or *au bain marie*	S2	C3
Hunter's meal	Beef/potatoes/red cabbage	Frozen	11 months	Heat for 12 minutes in a microwave oven of for 40 min in a conventional oven	S3	C3
Vegetarian lasagne	Broccoli/carrots/pasta/tomatoes/onion	Frozen	1.5 years	Heat for 14 min in a microwave oven or for 40 min in a conventional oven	S4	C3
Babi Ketjap	Pork/rice/onion/tomato	Refrigerated	15 days	Heat for 4 min in a microwave oven or for 20 min in a conventional oven or *au bain marie*	S2	C2
Pasta salad	Salmon/pasta/apple/carrots/broccoli	Refrigerated	23 days	None	S2	C1
Pizza Verdura	Cheese/pizza base/tomato/maize/broccoli	Frozen	10 months	Heat for 12–15 min in a conventional oven	S3	C2

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