

# A Practical Application of Argumentation in French Agrifood Chains

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**Abstract.** Evaluating food quality is a complex process since it relies on numerous criteria historically grouped into four main types: nutritional, sensorial, practical and hygienic qualities. They may be completed by other emerging preoccupations such as the environmental impact, economic phenomena, etc. However, all these aspects of quality and their various components are not always compatible and their simultaneous improvement is a problem that sometimes has no obvious solution, which corresponds to a real issue for decision making. This paper proposes a decision support method guided by the objectives defined for the end products of an agrifood chain. It is materialized by a backward chaining approach based on argumentation.

## 1 Introduction

In agrifood chains, the products traditionally go through the intermediate stages of processing, storage, transport, packaging and reach the consumer (the demand) from the producer (the supply). More recently, due to an increase in quality constraints, several parties are involved in the production process, such as consumers, industrials, health and sanitary authorities, expressing their requirements on the final product as different points of view which could be conflicting. The notion of reverse engineering control, in which the demand sets the specifications of desired products and it is up to the supply to adapt and find its production requirements to respond, can be considered in this case.

In this article, we discuss two aspects of this problem. First, we accept the idea that specifications cannot be established and several complementary points of view - possibly contradictory - can be expressed (nutritional, environmental, taste, etc.). We then need to assess their compatibility (or incompatibility) and identify solutions satisfying a maximum set of viewpoints. To this end we proposed a logical framework based on argumentation and introduced a method of decision making based on backward chaining for the bread industry. This method detects inconsistencies and proposes several options to solve the problem.

Since a joint argumentation - decision support approach is highly relevant to the food sector [24], the **contribution** of the paper is **to present a real use case of an argumentation process in the agrifood domain**. For technical details (such as the way we introduce the notion of viewpoint / goal in this setting based on the notion of backwards chaining reasoning and show how to use those

techniques in a concrete application) please check the technical report [11] which complements this paper in terms of technical results. **In this paper we aim at solely presenting the practical application of argumentation and how it can benefit the agri-food domain.** In Section 2, we introduce the real scenario considered in the application. In Section 3, we motivate our technical and modeling choices. In Section 4, the developed approach is introduced. It relies on an instantiation of a logic based argumentation framework based on a specific fragment of first order logic. In Section 5, we explain how to ensure the soundness and completeness of our agronomy application method. In Section 6, some evaluation results are presented. Finally, Section 7 concludes the paper.

## 2 Scenario

The case of study considered in this paper relates to the debate around the change of ash content in flour used for common French bread. Various actors of the agronomy sector are concerned, in particular the Ministry for Health through its recommendations within the framework of the PNNS (“National Program for Nutrition and Health”), the millers, the bakers, the nutritionists and the consumers. The PNNS recommends to privilege the whole-grain cereal products and in particular to pass to a common bread of T80 type, i.e made with flour containing an ash content (mineral matter rate) of 0.8%, instead of the type T65 (0.65% of mineral matter) currently used. Increasing the ash content comes down to using a more complete flour, since mineral matter is concentrated in the peripheral layers of the wheat grain, as well as a good amount of components of nutritional interest (vitamins, fibres). However, the peripheral layers of the grain are also exposed to the phytosanitary products, which does not make them advisable from a health point of view, unless one uses organic flour. Other arguments (and of various nature) are in favour or discredit whole-grain bread. From an organoleptic point of view for example, the bread loses out in its “being crusty”. From a nutritional point of view, the argument according to which the fibres are beneficial for health is discussed, some fibres could irritate the digestive system. From an economic point of view, the bakers fear selling less bread, because whole-grain bread increases satiety – which is beneficial from a nutritional point of view, for the regulation of the appetite and the fight against food imbalances and pathologies. However whole-grain bread requires also less flour and more water for its production, thus reducing the cost. The millers also fear a decrease in the quality of the technical methods used in the flour production.

*Beyond the polemic on the choice between two alternatives (T65 or T80), one can take the debate further by distinguishing the various points of view concerned, identifying the desirable target characteristics, estimating the means of reaching that point. **The contribution of this paper is showing how using argumentation can help towards such practical goals.***

### 3 Motivation

In this paper we will elicit the points of view and the desirable target characteristics by the means of interviews with agronomy experts. Once the target characteristics identified, finding the means of reaching them will be done automatically by a combination of reverse engineering and argumentation. *The reverse engineering will be used in order to find the complete set of actions to take towards a given characteristic, for all characteristics. In certain cases the actions to take will be inconsistent. Argumentation will then be employed in order to identify actions that can be accepted together.*

#### 3.1 Reverse Engineering

While reverse engineering has been widely employed in other Computer Science domains such as multi-agent systems or requirements engineering, it is quite a novel methodology when applied in agronomy. In agrifood chains, the products traditionally go through the intermediate stages of processing, storage, transport, packaging and reach the consumer (the demand) from the producer (the supply). It is only recently, due to an increase in quality constraints, that the notion of reverse engineering control has emerged. In this case the demand (and not the supply) sets the specifications of desired products and it is up to the supply to adapt and find its ways to respond. In what follows, starting from the desired target criteria for the final product, the methods allowing one to identify ways to achieve these criteria (by intervention on the various stages of the supply chain) are named “reverse engineering”.

Reverse engineering is known to be challenging from a methodological viewpoint. This is due to two main aspects. First, the difficulty of defining the specifications for the expected finished product. The desired quality criteria are multiple, questionable, and not necessarily compatible. The second difficulty lies in the fact that the impact of different steps of food processing and their order is not completely known. Some steps are more studied than others, several successive steps can have opposite effects (or unknown effects), the target criteria may be outside of the characteristics of products. Moreover, reconciling different viewpoints involved in the food sector still raises unaddressed issues. The problem does not simply consist in addressing a multi-criteria optimisation problem [7]: the domain experts would need to be able to justify why a certain decision (or set of possible decisions) is taken.

#### 3.2 Argumentation

Argumentation theory in general [16] is actively studied in the literature, some approaches combining argumentation and multi criteria decision making [1].

**Logic-Based Argumentation.** In this paper we present a methodology combining reverse engineering and logical based argumentation for selecting the actions to take towards the agronomy application at hand. The logical instantiation

language is a subset of first order logic denoted in this paper *SRC* equivalent to Datalog+ [9], Conceptual Graphs or Description Logics (more precisely the *EL* fragment [3] and DL-Lite families [10]). All above mentioned languages are logically equivalent in terms of representation or reasoning power. The reason why this application is using *SRC* is the graph based representation proper to *SRC* (and not to the other languages). This graph based representation (implemented in the Cogui tool) makes the language suitable for interacting with non computing experts [20]. More on the visual appeal of Cogui for knowledge representation and reasoning can be found in [20]. In the following we use the instantiation of [12] for defining what an argument and an attack is.

## 4 Approach

In a nutshell our methodology is as follows. The set of goals, viewpoints as well as the knowledge associated with the goals / viewpoints is elicited either by the means of interviews with the domain experts or manually from different scientific papers. This step of the application is the most time consuming but the most important. If the elicited knowledge is not complete, sound or precise the outcome of the system is compromised. Then, based on the knowledge elicited from the knowledge experts and the goals of the experts, we enrich the knowledge bases using reverse engineering (implemented using backwards chaining algorithms). Putting together the enriched knowledge bases obtained by backwards chaining from the different goals will lead to inconsistencies. The argumentation process is used at this step and the extensions yield by the applications are computed. Based on the extensions and the associated viewpoints we can use voting functions to determine the application choice of viewpoints.

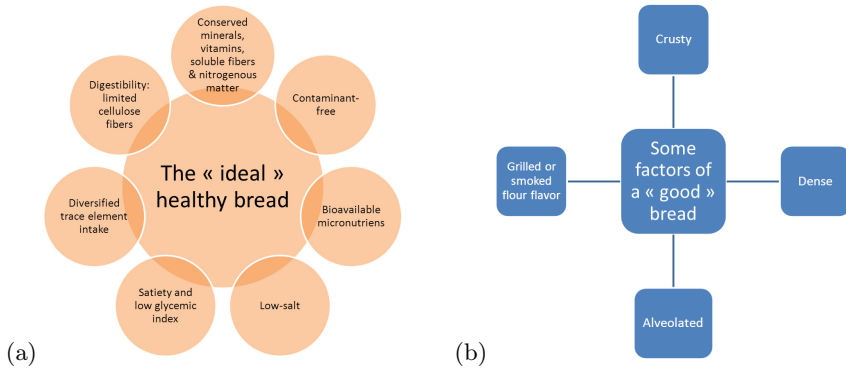
### 4.1 Use Case Real Data

Expressing the target characteristics – or goals – according to various points of view consists of identifying the facets involved in the construction of product quality: points of view, topics of concern such as nutrition, environment, technology, etc. In addition, such viewpoints have to be addressed according to their various components (fibres, minerals, vitamins, etc). Desirable directions need to be laid down, and we first consider them independent.

The considered sources of information include, from most formal to less formal: (1) peer reviewed scientific papers; (2) technical reports or information posted on websites; (3) conferences and scientific meetings around research projects; (4) expert knowledge obtained through interviews. The scientific articles we have analysed include: [6,23,15,19]. [6] compares the different types of flour from a nutritional point of view. [23] explores the link between fibre and satiety. [15] deals with consumer behaviour and willingness to pay. They focus on French baguette when information concerning the level of fibres is provided, and they base their results on statistical studies of consumer panels. [19] provides a summary of the nutritional aspects of consumption of bread and the link with technological aspects.

We also reviewed technical reports available on official websites on health policy: the public PNNS (National Program for Nutrition and Health) [21,22], the European project Healthgrain (looking at improving nutrition and health through grains) [13,18], as well as projects and symposia on sanitary measures regarding the nutritional, technological and organoleptic properties of breads [14,8,2,17]. Finally, several interviews were conducted to collect domain expert knowledge, in particular technology specialists in our laboratory.

A summary of the results obtained in the baking industry is synthesised in Figure 1 regarding the nutritional and organoleptic aspects.



**Fig. 1.** Nutritional (a) and organoleptic (b) goals

## 5 Technical Soundness

In this section we explain the technical results that ensure the soundness and completeness of our agronomy application method. The section is composed of three parts. A first subsection explains the logical subset of first order logic language employed in the paper. The second subsection deals with arguments and attacks and how to obtain extensions when a knowledge base expressed under this language is inconsistent. Last, the third section shows how we used reverse engineering to complete the knowledge base with all possible actions and how argumentation can be used in order to select consistent subsets of knowledge which support given actions.

### 5.1 The Logical Language

In the following, we give the general setting knowledge representation language used throughout the paper.

A knowledge base is a 3-tuple  $\mathcal{K} = (\mathcal{F}, \mathcal{R}, \mathcal{N})$  composed of three finite sets of formulae: a set  $\mathcal{F}$  of facts, a set  $\mathcal{R}$  of rules and a set  $\mathcal{N}$  of constraints. Please check the technical report [11] for more formal details on the elements of the

language. For space reasons, in the following we will simply give an intuition of the expressivity of this language by the means an example. We thus prefer to explain in detail the application contribution of the paper and keep the technical details fully accessible in the technical report [11].

Let  $\mathcal{K} = (\mathcal{F}, \mathcal{R}, \mathcal{N})$  where :

- $\mathcal{F} = \{F_1\} = \{CurrentExtractionRate(T65)\}$
- $\mathcal{R}$  contains the following rules:
  - $R_1 = \forall x, y (Bread(x) \wedge ExtractionRate(y, x) \wedge Decrease(y) \rightarrow Digestible(x))$
  - $R_2 = \forall x, z (Bread(x) \wedge SaltAdjunction(z, x) \wedge Decrease(z) \rightarrow LowSalt(x))$
  - $R_3 = \forall x, y (Bread(x) \wedge ExtractionRate(y, x) \wedge Growth(y) \rightarrow TraceElementRich(x))$
  - $R_4 = \forall x, y (Bread(x) \wedge ExtractionRate(y, x) \wedge Decrease(y) \rightarrow PesticideFree(x))$
- $\mathcal{N}$  contains the following negative constraint:
  - $N = \neg(\exists x (Growth(x) \wedge Decrease(x)))$

Reasoning consists of applying rules on the set  $\mathcal{F}$  and thus inferring new knowledge. A rule  $R = (H, C)$  is *applicable* to set  $\mathcal{F}$  if and only if there exists  $\mathcal{F}' \subseteq \mathcal{F}$  such that there is a homomorphism  $\sigma$  from the hypothesis of  $\mathcal{R}$  to the conjunction of elements of  $\mathcal{F}'$ . The rule application can be done using forward chaining (denoted  $R(F)$ ) or backwards chaining (denoted  $R^{-1}(F)$ ). A set  $\{F_1, \dots, F_k\} \subseteq \mathcal{F}$  is  $\mathcal{R}$ -*inconsistent* if and only if there exists a constraint  $N \in \mathcal{N}$  such that the closure of facts with the rules entails the negative constraint.

## 5.2 Arguments and Attacks

This section shows that it is possible to define an instantiation of Dung's abstract argumentation theory [16] that can be used to reason with an inconsistent ontological KB. The notion of argument and attack used here follow the one introduced by [12]. As previously explained we simply show an example of argument and (asymmetric) attack. Let us introduce some argumentation notions.

Given a knowledge base  $\mathcal{K} = (\mathcal{F}, \mathcal{R}, \mathcal{N})$ , the *corresponding argumentation framework*  $\mathcal{AF}_{\mathcal{K}}$  is a pair  $(\mathcal{A} = \text{Arg}(\mathcal{F}), \text{Att})$  where  $\text{Arg}(\mathcal{F})$  is the set of all arguments that can be constructed from  $\mathcal{F}$  and  $\text{Att}$  is the corresponding attack relation as specified in [12]. Let  $\mathcal{E} \subseteq \mathcal{A}$  and  $a \in \mathcal{A}$ . We say that  $\mathcal{E}$  is *conflict free* iff there exists no arguments  $a, b \in \mathcal{E}$  such that  $(a, b) \in \text{Att}$ .  $\mathcal{E}$  *defends*  $a$  iff for every argument  $b \in \mathcal{A}$ , if we have  $(b, a) \in \text{Att}$  then there exists  $c \in \mathcal{E}$  such that  $(c, b) \in \text{Att}$ .  $\mathcal{E}$  is *admissible* iff it is conflict free and defends all its arguments.  $\mathcal{E}$  is a *complete extension* iff  $\mathcal{E}$  is an admissible set which contains all the arguments it defends.  $\mathcal{E}$  is a *preferred extension* iff it is a maximal admissible set (with respect to set inclusion).  $\mathcal{E}$  is a *stable extension* iff it is conflict-free and for all  $a \in \mathcal{A} \setminus \mathcal{E}$ , there exists an argument  $b \in \mathcal{E}$  such that  $(b, a) \in \text{Att}$ .  $\mathcal{E}$  is a *grounded extension* iff  $\mathcal{E}$  is a minimal (for set inclusion) complete extension. An argument is sceptically accepted if it is in all extensions, credulously accepted if it is in at least one extension and rejected if it is not in any extension.

### 5.3 Formalising the Use Case

In this subsection we illustrate the applicative use of the argumentation notions in a goal-based inconsistent knowledge base obtained from an agri-food scenario.

Let the knowledge base defined in section 5.1 and the goal set  $\mathcal{G}$  as:

- $G_1 = \exists p (Bread(p) \wedge Digestible(p))$ ,  
where  $\kappa(G_1) = nutrition$
- $G_2 = \exists p (Bread(p) \wedge LowSalt(p))$ ,  
where  $\kappa(G_2) = nutrition$
- $G_3 = \exists p (Bread(p) \wedge TraceElementRich(p))$ ,  
where  $\kappa(G_3) = nutrition$
- $G_4 = \exists p (Bread(p) \wedge PesticideFree(p))$ ,  
where  $\kappa(G_4) = sanitary$ .

Then:

- $\mathcal{K}_1 = (\mathcal{F}_1, \mathcal{R}, \mathcal{N})$  where  $\mathcal{F}_1 = \mathcal{F} \cup \mathcal{R}^{-1}(G_1)$  contains the following facts:
  - $F_1 = CurrentExtractionRate(T65)$
  - $F_2 = Bread(p) \wedge ExtractionRate(\tau, p) \wedge Decrease(\tau)$
- $\mathcal{K}_2 = (\mathcal{F}_2, \mathcal{R}, \mathcal{N})$  where  $\mathcal{F}_2 = \mathcal{F} \cup \mathcal{R}^{-1}(G_2)$  contains the following facts:
  - $F_1 = CurrentExtractionRate(T65)$
  - $F_3 = Bread(p) \wedge SaltAdjunction(s, p) \wedge Decrease(s)$
- $\mathcal{K}_3 = (\mathcal{F}_3, \mathcal{R}, \mathcal{N})$  where  $\mathcal{F}_3 = \mathcal{F} \cup \mathcal{R}^{-1}(G_3)$  contains the following facts:
  - $F_1 = CurrentExtractionRate(T65)$
  - $F_4 = Bread(p) \wedge ExtractionRate(\tau, p) \wedge Growth(\tau)$
- $\mathcal{K}_4 = (\mathcal{F}_4, \mathcal{R}, \mathcal{N})$  where  $\mathcal{F}_4 = \mathcal{F} \cup \mathcal{R}^{-1}(G_4)$  contains the following facts:
  - $F_1 = CurrentExtractionRate(T65)$
  - $F_2 = Bread(p) \wedge ExtractionRate(\tau, p) \wedge Decrease(\tau)$

Finally  $\mathcal{K}_{agg} = (\mathcal{F} \cup_{i=1, \dots, n} \mathcal{R}^{-1}(G_i), \mathcal{R}, \mathcal{N})$  where  $\mathcal{F} \cup_{i=1, \dots, n} \mathcal{R}^{-1}(G_i) = \{F_1, F_2, F_3, F_4\}$ .

As observed in the previous example, it may happen that  $\mathcal{K}_{agg}$  is inconsistent (and it does so even for goals belonging to the same viewpoint). We then use argumentation, which, by the means of extensions will isolate subsets of facts we can accept together (called extensions). Furthermore, the extensions will allow us to see which are the viewpoints associated to each maximal consistent subset of knowledge (by the means of the function  $\kappa$ ). Once we obtain this we can either use simple voting procedures to find out which viewpoint to follow or other preference based selection.

The argument framework we can construct from the above knowledge base is  $(\mathcal{A}, Att)$  where  $\mathcal{A}$  contains the following:

- $a = (\{F_2\}, F_2, R_1(F_2))$  where  $R_1(F_2) = Bread(p) \wedge ExtractionRate(\tau, p) \wedge Decrease(\tau) \wedge Digestible(p)$ .
- $b = (\{F_4\}, F_4, R_3(F_4))$  where  $R_3(F_4) = Bread(p) \wedge ExtractionRate(\tau, p) \wedge Growth(\tau) \wedge TraceElementRich(p)$ .
- $c = (\{F_2\}, F_2, R_4(F_2))$  where  $R_4(F_2) = Bread(p) \wedge ExtractionRate(\tau, p) \wedge Decrease(\tau) \wedge PesticideFree(p)$ .

•  $d = (\{F_3\}, F_3, R_2(F_3))$  where  $R_2(F_3) = Bread(p) \wedge SaltAdjunction(s,p) \wedge Decrease(s) \wedge LowSalt(p)$  and  
 $Att = \{(a, b), (b, a), (b, c), (c, b)\}$ .

In the defined argumentation system, we can now derive:

•  $Ext_{stable}(\mathcal{A}, Att) = Ext_{semi-stable}(\mathcal{A}, Att) = Ext_{preferred}(\mathcal{A}, Att) = \{\{a, c, d\}, \{b, d\}\}$ .

Starting from the extensions  $Ext_x(\mathcal{A}, Att)$ , the proposed decision support system functions as follows: for every extension  $\varepsilon \in Ext_x(\mathcal{A}, Att)$  :

- Consider the facts occurring in the arguments of  $\varepsilon$  ;
- Identify the knowledge bases  $\mathcal{K}_i$  where these facts occur;
- Obtain the goals  $G_i$  which are satisfied by the extension;
- Using the  $\kappa$  function to obtain the viewpoints corresponding to these goals;
- Show domain experts the set of goals, and compatible viewpoints corresponding to the given extension.

This method allows us to obtain a set of options equal to the cardinality of  $Ext_x(\mathcal{A}, Att)$ . To make a final decision several possibilities can be considered and presented to the experts:

- Maximise the number of goals satisfied;
- Maximise the number of viewpoints satisfied;
- Use preference relations of experts on goals and / or viewpoints.

In the previous example (please recall that the goals  $G_1$  and  $G_2$  are associated with the nutritional viewpoint while  $G_4$  is associated with the sanitary viewpoint) we have:

- The first extension  $\{a, c, d\}$  is based on the facts  $F_2$  and  $F_3$  obtained from  $\mathcal{K}_1, \mathcal{K}_2$  and  $\mathcal{K}_4$  that satisfy the goals  $G_1, G_2$  and  $G_4$ .
- The second extension  $\{b, d\}$  is based on  $F_3$  and  $F_4$  obtained from  $\mathcal{K}_2$  and  $\mathcal{K}_3$  satisfying  $G_2$  and  $G_3$  both associated with the nutritional viewpoint.

One first possibility (corresponding to the extension  $\{a, c, d\}$ ) consists of accomplishing  $F_2$  and  $F_3$  and allows to satisfy the biggest number of goals and viewpoints.

The second possibility (corresponding to the extension  $\{b, d\}$ ) consists of accomplishing  $F_3$  and  $F_4$ . It would satisfy two goals and one viewpoint. It could be considered though if the goal  $G_3$  (not satisfied by the first option) is preferred to the others.

## 6 Evaluation

The evaluation of the implemented system was done via a series of interviews with domain experts. The above knowledge and reasoning procedures were implemented using the Cogui knowledge representation tool [20], with an extension of 2000 lines of supplemental code. Three experts have validated our approach:



two researchers in food science and cereal technologies of the French national institute of agronomic research, specialists respectively of the grain-to-flour transformation process and of the breadmaking process, and one industrial expert - the president of the French National Institute of Bread and Pastry.

The first meeting dealt with the delimitation of the project objectives and addressed fundamental questions such as: Is it possible to uniquely define a “good” bread? Which scenarii of “good bread” should be considered? How could they be defined from a nutritional, sanitary, sensorial and economic point of view? Which are the main known ways to achieve them? Then a series of individual interviews constituted the elicitation phase. Each expert gave more arguments which were complementing one another.

In the following plenary meeting the real potential of the approach was shown. The experts were formulating goals and viewpoints they were interested in and the Cogui system together with the argumentation extension was yielding the associated possible propositions.

Two interests of the approach were more particularly highlighted. They concern cognitive considerations. Firstly, experts were conscious that the elicitation procedure was done according to their thought processes, that is, in a forward way which is more natural and intuitive. The system was thus able to reconstitute the knowledge in a different manner than the experts usually do. Secondly, from a problem that could initially seem simple, the experts realized that it covered a huge complexity that a human mind could hardly address on its own. The tool is currently available to them under restricted access.

## 7 Conclusion

Even if argumentation based decision making methods applied to the food industry were also proposed by [4,5], this paper addresses a key issue in the context of current techniques used by the food sector and namely addressing reverse engineering. Moreover, in this approach, an argument is used as a method computing compatible objectives in the sector. This case study represents an original application and an introspective approach in the agronomy field by providing an argumentation based decision-support system for the various food sectors. It requires nevertheless the very expensive task of knowledge modeling. Such task, in its current state cannot be automated. It strongly depends on the quality of expert opinion and elicitation (exhaustiveness, certainty, etc). The current trend for decision-making tools includes more and more methods of argumentation as means of including experts in the task of modeling and the decision-making processes. Another element to take into account, not discussed in this paper, is the difficulty of technologically (from an agronomy viewpoint) putting in place the facts of each option. Modeling this aspect in the formalism has still to be studied.

## References

1. Amgoud, L., Prade, H.: Using arguments for making and explaining decisions. *Artificial Intelligence* 173(3-4), 413–436 (2009)
2. AQUANUP (2009), [http://www.inra.fr/inra\\_cepia/vous\\_recherchez/des\\_projets/france/aquanup](http://www.inra.fr/inra_cepia/vous_recherchez/des_projets/france/aquanup)
3. Baader, F., Brandt, S., Lutz, C.: Pushing the envelope. In: Proc. of IJCAI 2005 (2005)
4. Bourguet, J.-R.: Contribution aux methodes d'argumentation pour la prise de decision. Application a l'arbitrage au sein de la filiere cerealiere. Thèse de doctorat, Université Montpellier II, Montpellier, France (2010)
5. Bourguet, J.-R., Thomopoulos, R., Mugnier, M.-L., Abécassis, J.: An artificial intelligence-based approach to deal with argumentation applied to food quality in a public health policy. Accepted for Publication in: *Expert Systems With Applications* (2013)
6. Bourre, J.-M., Bégat, A., Leroux, M.-C., Mousques-Cami, V., Pérandel, N., Souply, F.: Valeur nutritionnelle (macro et micro-nutriments) de farines et pains français. *Médecine et Nutrition* 44(2), 49–76 (2008)
7. Bouyssou, D., Dubois, D., Pirlot, M., Prade, H.: Decision-making process – Concepts and Methods. Wiley (2009)
8. CADINNO. Information, choix, consommateurs responsables: des leviers pour un développement durable? (2008), [http://www.melissa.ens-cachan.fr/IMG/pdf/Colloque\\_CadInno\\_FR.pdf](http://www.melissa.ens-cachan.fr/IMG/pdf/Colloque_CadInno_FR.pdf)
9. Cali, A., Gottlob, G., Lukasiewicz, T., Marnette, B., Pieris, A.: Datalog+/-: A family of logical knowledge representation and query languages for new applications. In: LICS, pp. 228–242 (2010)
10. Calvanese, D., De Giacomo, G., Lembo, D., Lenzerini, M., Rosati, R.: Tractable reasoning and efficient query answering in description logics: The dl-lite family. *J. Autom. Reasoning* 39(3), 385–429 (2007)
11. Croitoru, M., Thomopoulos, R., Tamani, N.: Using argumentation in a french agrifood chain application: Technical report. Technical report, GrapIK, INRIA, University of Montpellier 2 (December 2013)
12. Croitoru, M., Vesic, S.: What can argumentation do for inconsistent ontology query answering? In: Liu, W., Subrahmanian, V.S., Wijsen, J. (eds.) SUM 2013. LNCS, vol. 8078, pp. 15–29. Springer, Heidelberg (2013)
13. Dean, M., Sheperd, R., Arvola, A., Lampila, P., Lahteenmaki, L., Vassalo, M., Saba, A., Claupein, E., Winkelmann, M.: Report on consumer expectations of health benefits of modified cereal products. Technical report, University of Surrey, UK (2007)
14. DINABIO. Proceedings of dinabio développement et innovation en agriculture biologique (2008), [http://www.inra.fr/ciag/revue\\_innovations\\_agronomiques/volume\\_4\\_janvier\\_2009](http://www.inra.fr/ciag/revue_innovations_agronomiques/volume_4_janvier_2009)
15. Dubuisson-Quellier, S.: De la routine à la délibération. les arbitrages des consommateurs en situation d'achat. *Réseaux* 135/136, 253–284 (2006)
16. Dung, P.M.: On the acceptability of arguments and its fundamental role in non-monotonic reasoning, logic programming and  $n$ -person games. *Artificial Intelligence Journal* 77, 321–357 (1995)
17. FCN. Fibres, céréales et nutrition (2009), <http://www.inra.fr/content/view/full/24670029>,
18. HEALTHGRAIN (2009), <http://www.healthgrain.org>

19. Layat, T.: Place du pain dans l'équilibre alimentaire. *Pratiques en Nutrition* 7(26), 45–50 (2011)
20. Michel, C., Mugnier, M.-L., Croitoru, M.: Visual reasoning with graph-based mechanisms: the good, the better and the best. *The Knowledge Engineering Review* 28, 249–271 (2013)
21. PNNS (documents statutaires) (2010),  
[http://www.sante.gouv.fr/htm/pointsur/nutrition/pol\\_nutri4.htm](http://www.sante.gouv.fr/htm/pointsur/nutrition/pol_nutri4.htm)
22. PNNS (site web) (2010),  
<http://www.mangerbouger.fr/menu-secondaire/pnns/1e-pnns>
23. Slavin, J., Green, H.: Dietary fibre and satiety. *British Nutrition Foundation* 32(1), 32–42 (2007)
24. Thomopoulos, R., Charnomordic, B., Cuq, B., Abécassis, J.: Artificial intelligence-based decision support system to manage quality of durum wheat products. *Quality Assurance and Safety of Crops & Foods* 1(3), 179–190 (2009)