

Killing day-old chicks? Public opinion regarding potential alternatives

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Abstract

Throughout the world, male chicks from layer breeds are killed just after hatching, as they are not profitable as regards the production of meat. The Dutch and European parliaments have insisted on research into possible alternatives to the killing of day-old chicks. In the present study we have investigated Dutch public opinion on the acceptability of these alternatives by means of discussions in so-called focus groups and via a public survey through computer-aided personal interviews (CAPI). To inform the participants about the subject, a film was made to explain the current practice and introduce a number of technological alternatives that would prevent development of male embryos, as well as the possibility of creating a 'dual-purpose chicken' that would allow male chicks to be used for meat production. The topics addressed in the study included the willingness of participants to pay a premium for eggs and chicken meat, were it necessary to prevent killing of male chicks. Focus-group discussions showed that many participants were unaware of the current practice of killing male chicks, and were shocked by this practice. However, once informed, the participants seemed able to take various considerations into account and rank the alternatives. The alternatives 'looking into the fresh egg (to determine sex of the egg and not incubate male eggs)', and 'dual-purpose chickens' scored best out of all the possible alternatives, and higher than maintaining the current practice. 'Influencing the laying hens such that they produce fewer male eggs' scored the same as maintaining the current practice. The use of 'genetic modification to facilitate looking into the fresh egg' scored only slightly lower than maintaining the current practice. Alternatives whereby developing male embryos die, or are killed, scored lower than maintaining the current practice.

Keywords: animal ethics, animal welfare, chicks, killing, laying hens, public opinion

Introduction

The commercial poultry industry is highly specialised throughout the world. There are breeds specialised in laying eggs, others in producing meat. Since males of laying breeds do not produce eggs and are not profitable, as regards meat production, they are killed immediately after hatching. This happens throughout the world and is carried out in conventional as well as organic poultry farming. The use of specialised breeds, which led to the practice of killing male chicks, has already been practised for approximately 50 years. In the EU, nearly 280 million laying hen chicks hatch annually for the production of new laying hens. Consequently, approximately 280 million male, day-old chicks are killed annually in the EU. Killing of newly hatched chicks is generally not considered an animal welfare problem, provided the killing is carried out in such a way, that it does not cause (unnecessary) anxiety or pain. According to EU regulations, two methods are permissible for the killing of groups of chickens and both are considered acceptable in terms of welfare. These methods are asphyxiation by an inert gas, such as CO₂ or argon, and shredding

(mechanical destruction that ensures immediate death) (EU Council Directive 93/119/EC). In The Netherlands, asphyxiation is preferred, as the day-old chicks killed in this manner can be (and are) marketed as whole chicks as feed for pets and zoo animals. In the UK, shredding is preferred as it causes instant death. Shredded chicks can only be used in compound feeds for pet animals. There is more demand for whole chicks than for the shredded ones.

The mass killing of day-old chicks raises ethical discussions (see Intergroup on the Welfare and Conservation of Animals 2008, Ministry of Agriculture, Nature and Food Quality 2007 and 2008). Many people view the killing of these young animals as an example of instrumentalisation of animals in current production systems (Aerts *et al* 2009). Due to the aversion to killing day-old male chicks, experiments have been performed in a number of countries to rear layer-type males to a live weight of approximately 600 g and market them as an alternative for quail, or to a live weight of approximately 2,000 g and market them as an alternative to broiler chickens (Schaublin *et al* 2005; Koenig *et al* 2009). The conclusion from those experiments was that the layer-

type males require virtually twice the amount of feed and three times as much time to reach the required bodyweight, compared to broilers. Slaughter yields and meat quality were not judged positive compared to broilers.

The Dutch parliament has insisted on research into potential alternatives to the killing of day-old chicks. The Dutch Ministry of Agriculture, Nature and Food Quality commissioned a study to make an inventory of potential technological possibilities that would obviate the killing of day-old males (Woelders *et al* 2007).

Before deciding upon investing in a possible alternative, the Ministry has ordered a study into which solutions are considered socially acceptable (Ministry of Agriculture, Nature and Food Quality 2007). The aim of the present study was to gain an insight into public opinion surrounding the technological alternatives to the killing of day-old male chicks.

Broader socio-ethical discussions regarding current systems of animal production and consumption of animal products (eg Singer 1975; Regan 1983) are relevant to the issue of killing of day-old chicks. For instance, a large-scale conversion to vegetarian or, indeed, vegan consumption patterns could reduce the problem of the killing of day-old chicks and would make technological revisions to the current system of egg production less urgent. However, the prospects for such a transition seem rather limited in the short and medium term. The Netherlands has seen a rise in the consumption of eggs from about 11 kg per person per year in 1973 to about 15 kg in 2009 and this level of consumption is estimated to rise further to 16 kg in the coming decade, whereas the consumption of chicken meat has tripled from approximately 7 to 21 kg per person per year for the same timeperiod and is estimated to further rise to more than 25 kg in the upcoming decade (PVE 2010). Similar figures prevail for other northwest European countries and, worldwide, the FAO expects a significant increase in the consumption of eggs and poultry meat (FAO 2010). A mere stabilisation of egg and chicken meat consumption levels in Europe would thus already be a major accomplishment. Therefore, we believe that a socially acceptable alternative to the killing of day-old chicks is valuable as an intermediate revision of the current system of egg production. This study was focused on the socio-ethical acceptability of potential (technological) alternatives to killing day-old chicks. The paper deliberately includes the more system-critical alternative of reintroducing a dual-purpose chicken in response to the issue of killing day-old chicks.

Materials and methods

Information to participants

The current practice of killing male, day-old chicks is not generally known to the public (Leenstra *et al* 2008; Aerts *et al* 2009). Moreover, the issue of the rationale for this practice and its potential (technological) alternatives may be complex. Consequently, straightforward questionnaires are insufficient to formulate an informed opinion of the general public. For this reason, a documentary film was made to

explain the current practice and to introduce eight technological alternatives, as well as the alternative of a 'dual-purpose chicken'. A dual-purpose chicken is a breed of chicken that would be suited both to egg and meat production. The cost price of eggs and meat depends on the production efficiency, and are mainly determined by feed and housing costs (per egg or per kg of meat). As the traits for egg production and growth rate are conflicting, the dual-purpose chicken would be less efficient in egg-laying and meat production compared with specialised layer and broiler breeds, respectively. On the other hand, the dual-purpose chicken would have a better egg-laying quality than broiler breeds, and a better meat production than layer breeds. Based on expert opinion, we assumed that the dual-purpose chicken would attain an adult weight of approximately 3,000 g, instead of 2,000 g for current layers, and that males would reach a slaughter weight of 2 kg at 14 weeks of age, instead of 5.5 weeks for current broilers. With these assumptions, it can be estimated that consumer prices of eggs and meat would double compared to eggs and meat from specialised breeds.

Also, the technological alternatives were introduced. The eight technological alternatives were subdivided into three categories: 'looking into the egg'; 'changing the hen'; and 'genetic modification'. The alternatives to killing day-old chicks are summarised in Table 1. The film contained eight blocks of information. After each block questions were asked. Table 2 shows the blocks of information and the questions asked.

In the present study, we have investigated the opinion of the Dutch public regarding the acceptability of these alternatives by means of discussions in so-called focus groups and by a public survey through computer-aided personal interviews (CAPI), as explained below.

Focus groups

Focus groups are a proven instrument for obtaining an insight into opinions and concerns and the underlying reasoning and motivation behind them where topics with limited public exposure, such as the killing of day-old chicks, are considered (Barbour & Kitzinger 1999; Bloor *et al* 2001; Elliot *et al* 2006). The participants are stimulated to form an opinion through information on the topic and interactions in the group. Focus groups do not give a representative picture of what the general public thinks about a topic. There were six focus groups, with seven or eight participants each. The most important criteria for constituting focus groups with various compositions were sex, and residential environment (town and countryside) of the participants, as these factors appear to influence people's opinions on issues regarding animal welfare (Evans & Miele 2007). One heterogeneous group (equal representation of males and females, town and countryside) was used early in the study as a pilot to test the information provided. After the pilot, one heterogeneous group and four 'focused' groups (town-male, town-female, country-male, country-female, respectively) were used. In each focus group there was a vegetarian and/or consumer of organic food. In each

Table 1 Possible alternatives to killing male chicks.

Factor	Explanation
Looking into the egg	1 Examine samples from freshly laid eggs to sex the eggs and not incubate male eggs
	2 Examine samples from early embryos and destroy the male embryos
	3 Examine late embryos and destroy the male embryos
Changing the hen	4 Influence the hens by environmental factors such that they produce fewer male eggs
	5 Crossing the parents in such a way that male embryos are not viable
Genetic modification	6 Influence the chicken by genetic modification to facilitate sexing of freshly laid eggs (eg by a photogenic gene of a firefly) and not incubate male eggs
	7 Influence the chicken by genetic modification such that male embryos become female chickens
	8 Influence the chicken by genetic modification such that the male embryos die during early development
The technological alternatives were complemented with the options	9 Accepting the current practise of killing day-old chicks
	10 Less specialised chickens, so that the males can be used for meat production ('dual-purpose chicken')

Only the alternative 'looking into the egg, late embryo' has been successfully carried out in the laboratory, but not on a practical scale yet. The other options are all in an experimental stage (see for details Woelders *et al* 2007). The technological alternatives would have a great impact on the level of the hatcheries, but do not really change the production of eggs and broiler meat. The dual-purpose chicken would affect production systems, as the hens are bigger than the current laying hens and produce fewer eggs, and the males need more time to reach the desired weight than the current broilers.

focus group there was a mix of ages, education and composition of the household. People with very strict religious principles and poultry farmers were excluded from the focus groups. Discussions in the focus groups lasted about two hours, including information from the film. There were no replicates for the various group categories, as this part of the study was intended to render qualitative results.

Computer-aided personal interviews

As focus groups do not provide a representative picture of the opinion of the general public, a public survey was set up and carried out through CAPI (computer-aided personal interviews). The results of the focus groups were used to develop the questionnaire, which included the information film, mentioned above, and contained both multiple-choice questions and questions with Likert scales from 1 ('I do not agree at all') to 7 ('I fully agree'). The questionnaire was first tested on a group of 44 Dutch students. After some adjustments, the questionnaire was sent via the internet to 2,500 individuals of 18 years or older that were randomly selected from a panel of a marketing research agency. The aim was to have at least 1,000 completed inquiries but within a week already about 1,200 completed forms had been returned.

Interpretation and evaluation of results

The results of the focus-group discussions and the public survey were discussed during a workshop in which five ethicists from four different Dutch universities, and representatives of a poultry breeding company, a hatchery, an animal welfare organisation and the government, took part.

Results

The results from focus groups and the public survey are presented separately below. The results of the focus groups are qualitative and presented as text. The results of the public survey are quantitative and presented in tables.

Focus groups

General attitude

The discussions in the focus groups, although different in terms of detail, were comparable. Most participants said they deliberately buy barn eggs. Not all participants were aware of the fact that Dutch supermarkets do not sell cage eggs any more. Only a limited number of participants bought free-range or organic eggs. One participant had chickens for egg production at home. Most participants had no clear idea about what happened with male chicks. They thought the chicks were used for meat or animal feed. Then, the information about the killing of male chicks was presented. The participants were shocked at first. However, they did not stick to this initial response, and were able to discuss a broad variety of considerations. Especially in the group of town women, the question was raised repeatedly why technological solutions for killing day-old chicks would be required, as the males are used as feed for zoo animals. Most participants preferred killing by CO₂ compared to shredding as the chicks could then be used as feed for zoo animals or pets. Only a limited number of participants preferred shredding, as it was quicker and 'less bad' for the chick.

Table 2 Questions used in focus groups and in the internet survey, with the multiple-choice options of the internet survey indicated between brackets.

Category	Question
Block 1 General	How many eggs do you eat (none, 1 per week, 2-3 per week, > 3 per week) Which type of eggs do you buy (none, barn eggs, free range, organic, other) Which criteria do you use (price, hens' living circumstances, hens' nutrition, other) What is the price of an egg (0-9 ct, 10-19 ct, 20-29 ct, > 30 ct)
Block 2 Killing day-old chicks	Did you know that one-day-old male chicks are killed (yes, no) What do you think about it (no problem, not a fine idea, bad, very bad)
Block 3 Methods of killing	If killing is inevitable which method do you prefer (with carbon dioxide, maceration) Which of the following statements comes closest to your opinion on killing male chicks (there is probably no alternative if food is to be produced on a large scale, it should be done neatly, I would like someone to find an alternative, the chicks are used as feed anyway, because of this I buy less eggs, or think of buying less eggs)
Block 4 Dual-purpose chicken (with information that the price, the amount of feed required, and the amount of manure produced per unit of produced meat and eggs would approximately double)	What is your point of view (I favour a dual-purpose chicken) (I am against a dual-purpose chicken)
Block 5 Alternatives	Which type of alternative do you favour (look in the egg, change the hen, both, none) A number of questions to indicate on a 7-point scale (from 1 totally disagree to 7 completely agree) It is acceptable to look in the fresh egg and destroy male eggs It is acceptable to look in the egg early in the incubation process and destroy male embryos Followed by choices between pairs of two options
Block 6 Change the hen	A number of questions to indicate on a 7-point scale from 1 totally disagree, to 7 completely agree It is acceptable to influence the hen by environmental factors (feed, light, presence of males, etc) to produce only female progeny It is acceptable to breed a chicken that lays eggs with male embryos that are not viable Followed by a choice between the two options
Block 7 Genetic modification	A number of questions to indicate on a 7-point scale from 1 totally disagree, to 7 completely agree It is acceptable to produce by genetic modification poultry of which the sex of the embryo can be recognised in the freshly laid egg It is acceptable to produce by genetic modification poultry in which genetic males become phenotypical females It is acceptable to produce by genetic modification poultry in which male embryos are not viable Followed by choices between pairs of two options
Block 8 Alternatives ranked	Rank above preferred alternatives of blocks 5, 6 and 7 and the added alternatives of 'dual-purpose chicken' and 'maintaining the current practice of killing' How important were the following reasons for the ranking you gave (on the 7-point scale, from 1 not important at all to 7 very important) Naturalness Animal-friendly Moral concerns Costs Feasibility Food safety Males are used as animal feed Are you prepared to pay more for an egg if your preferred alternative is realised (no, 5-10 ct premium, 11-25 ct premium, 26-50 ct premium). For those respondents that preferred the dual-purpose chicken: are you prepared to pay more for poultry meat (no, 1-2 € per kg extra, 3-4 € per kg extra, 5-10 € per kg extra)

Dual-purpose chicken

All groups were initially positive to the concept of a dual-purpose chicken, but all groups also discussed that a dual-purpose chicken was not very realistic. All groups considered a two-fold increase in the price of eggs and poultry meat as too much. Only a limited number of individuals said they would be prepared to pay two-fold for eggs from dual-purpose chickens. All groups, with the exception of the 'town-male' group, indicated that many products would increase in price, as eggs are used in many products.

Killing embryos, and sex determination in the freshly laid egg

In all groups, a number of participants found that killing embryos is not an option (town male), or a disadvantage (all other groups). None of the groups liked the use of lethal factors that would cause male embryos to die. Sex determination in the freshly laid egg was considered acceptable, especially when the egg could be utilised afterwards (countryside female).

Influencing the hen to produce only female offspring

All groups considered influencing the hen via environmental factors to produce only female offspring as an attractive option ('nice', 'simple', 'animal-friendly'). A limited number of individuals were opposed to this option ('I am against this manipulation of the chicken').

Genetic modification

Genetic modification was controversial: a majority of the participants were against genetic modification. 'Naturalness' was often mentioned in the discussions about genetic modification. A number of participants were more or less neutral about genetic modification; they noticed advantages and disadvantages for the different options, but did not oppose genetic modification, as such. Risks of genetic modification for human health and animal welfare were used as arguments against genetic modification. A number of participants favoured genetic modification: 'for human health genetic modification has provided a lot of good developments. We should use our knowledge to prevent killing of day-old chicks'. The two male groups were more positive about genetic modification than the female and the heterogeneous groups. If participants were in favour of genetic modification, they favoured the option to identify male embryos in freshly laid eggs above sex reversal.

Overall preferences

At the end of the session, the participants were asked to list their overall preferences. The participants considered the whole issue as complicated, particularly when they had to give an order of preference to the presented alternatives (eg, one of the expressions of one of the participants was 'my brains start to crack'). They often required more information, for example about whether the alternatives were feasible, or about the exact impact on the chicken. However, because the alternatives are often theoretical possibilities that are largely untested in practice or even in experiments, such information is not yet available. There seemed to be no clear best or worst option. In most groups there was

variation within the groups in the ranking of alternatives, with the exception of the last heterogeneous group. The participants of the latter group were unanimously in favour of looking into the fresh egg. In the group of town men, most participants preferred genetic modification to facilitate sexing of freshly laid eggs. In the other groups, the alternatives of dual-purpose chickens, genetic modification to facilitate sexing of freshly laid eggs, influencing the hen to produce only female offspring, and accepting the killing of day-old chicks ranked high. In total, the number of times an option was mentioned as first or second preference were:

- Looking in the fresh egg (18 times);
- Influencing the hen (16 times);
- Dual-purpose chickens (14 times);
- Genetic modification, for sex determination in the freshly laid egg (12 times);
- Accepting the present practice of killing day-old chicks (four times).

Relatively more participants from the countryside were in favour of a dual-purpose chicken compared to participants from towns.

Considerations, reasons and arguments

'Animal friendliness' was an often-mentioned argument in the focus groups. 'Humane' and 'animal-friendly' were used indiscriminately. Killing the day-old chicks and destroying male embryos late in the incubation process were considered 'animal-unfriendly', while the alternatives 'dual-purpose chicken', 'influencing the sex ratio by adapting the environmental factors of the hen' and 'looking into the egg and not incubating male eggs' were regarded as animal-friendly.

According to the participants in the focus groups, naturalness means that intervention with 'nature' or 'animal' is as little as possible. This argument was used both to plea in favour of or against particular options. Many participants considered influencing environmental factors a natural method, whereas genetic modification was regarded as 'unnatural'. The meaning of 'naturalness' was not the same to all participants. The participants had different opinions about how invasive a certain alternative would be. One of the respondents, for example, indicated that influencing the environmental factors was a further manipulation of nature, and those in favour of genetic modification (GM) differentiated between the various GM-alternatives depending on the extent of naturalness of the intervention.

Also, the risks for human and animal safety and moral considerations played a role, particularly in the discussion about genetic modification. For a number of participants, the GM-methods were not an option. Statements as 'one bridge too far' or 'unethical' indicate that moral boundaries had been exceeded. These statements were mentioned together with the 'unnatural' character of genetic modification ('nothing is natural here'), ie moral considerations seem to run parallel with considerations about (un)naturalness.

More practical considerations, such as costs and feasibility of the method, price of eggs and meat, manure output and

Table 3 Socio-demographic characteristics of the respondents in the public survey, and of the total Dutch population older than 18.

Characteristic	Respondents (n = 1,199)	Dutch population (older than 18 years of age)
Age (average)	43	40
Gender		
Male	53%	49%
Female	47%	51%
Responsible for children		
Yes	39%	58%
No	61%	42%
No of persons in household		
One	16%	16%
Two	36%	29%
Three or more	48%	55%
Education		
Higher	40%	26%
Average	40%	40%
Low	20%	39%
Personal wealth*		
High	23%	23%
2	19%	19%
3	23%	21%
4	29%	30%
Low	6%	6%

* Wealth is classified according to Dutch National Research Multimedia (NOM 2008).

the use of day-old chicks, also played an important role in the focus groups. The higher costs of eggs (and egg products) and the manure output were important reasons for some participants to be against the dual-purpose chicken. Other participants considered 'looking into the egg' a complicated alternative, while seeing GM as a quick and efficient alternative. The utilisation of day-old chicks as feed for zoo animals was an argument in favour of maintaining the current situation. Although these arguments were mentioned regularly, they were not always decisive. The fact that sex determination in the late embryo can be realised in the short term, and can thus be considered the most feasible alternative, did not offset the aversion to killing the embryo. On the other hand, the higher costs of eggs and meat from dual-purpose chickens did not prevent some participants from mentioning it as first or second preference. Lastly, it should be mentioned that a number of participants believed that the laying hen does not have a bright life anyway. The current practice of keeping laying

hens was, however, also an argument against the dual-purpose chicken. For some members of the focus groups this was a reason not to think about these issues a lot. Others believed that the consumer should be far more aware of these practices. In the focus groups, costs and price were frequently discussed. A number of people indicated a willingness to pay more to prevent killing the chicks.

Public survey

General information

The socio-demographic characteristics of the respondents are presented in Table 3. Slightly more than half of the respondents were men. Most of the households consisted of more than two people (48%) and the majority (61%) of the respondents were not responsible for children. The education level of most of the respondents varied between high and middle level (40% each), which is a slight overrepresentation of the average Dutch population (see Table 3).

The survey showed that 58% of the respondents were not aware that chicks of laying breeds are killed right after hatching. Half of the respondents felt 'uncomfortable' about the killing, while another 36% found it 'bad' or 'very bad'. A search for alternatives to killing chicks was considered to be useful by 58% of the respondents. Two-thirds of respondents were willing to consider the dual-purpose chicken as an alternative; one-third were against it.

Acceptability of alternatives

Considering the acceptability of eight technological alternatives to killing of day-old chicks scored by all respondents on a 7-point Likert scale (Table 4), the following three alternatives scored high and may be considered socially acceptable (Likert scores > 4.2):

- Examining samples from unincubated eggs (to determine the sex of the egg and not incubate male eggs);
- Influencing the laying hens by environmental factors such that they produce fewer male eggs; and
- Influencing the chicken by genetic modification such that unincubated eggs can be sexed.

Overall preference

As explained above, the technological alternatives were subdivided in three categories: 'looking into the egg', 'changing the hen' and 'genetic modification' (Table 1). Within each category, respondents were forced to make a choice between pairs of alternatives, until each respondent would have one preferred option per category (ie three preferred options). Then, respondents were asked to rank their three personal preferred options plus two extra alternatives: i) 'dual-purpose chicken', and ii) 'accepting the current practice of killing day-old chicks'. With respect to the percentage of respondents choosing an alternative as their respective first preference there was a clear top five (Table 5). 'Looking into the fresh egg and not incubate male eggs' and 'dual-purpose chicken' had higher scores than all other options and ranked virtually equal. 'Accepting the current practice of killing' and 'influencing the chicken by environ-

Table 4 Mean (\pm SD) scores on a 7-point scale for acceptability of technological alternatives to killing day-old chicks, in order of acceptability (n = 1,199).

Alternative	Score*
It is acceptable to look in the freshly laid egg, and destroy male eggs	5.58 (\pm 1.63)
It is acceptable to influence the hen with environmental factors to produce only female progeny	5.19 (\pm 1.73)
It is acceptable to use genetic modification to produce poultry of which the sex of the embryo can be recognised in the freshly laid egg	4.27 (\pm 1.91)
It is acceptable to establish the sex of an embryo early in incubation and destroy male embryos	4.12 (\pm 1.79)
It is acceptable to breed a chicken that lays eggs with male embryos that are not viable	3.73 (\pm 1.91)
It is acceptable to use genetic modification to change males into females	3.42 (\pm 1.87)
It is acceptable to establish the sex of an embryo late in incubation and destroy male embryos	3.19 (\pm 1.87)
It is acceptable to use genetic modification to produce a chicken with non-viable male progeny	3.01 (\pm 1.67)

* All differences between scores are significant (paired sample *t*-test, $P < 0.05$).

mental factors, such that they produce fewer male eggs' ended at a somewhat lower, almost equal score. 'Adapting the chicken by genetic modification, such that the sex of freshly laid eggs can be recognised' ended fifth. All other possibilities had clearly lower scores.

Socio-demographic variables and preferences

The relationship between socio-demographic variables and the first choice of the respondents was examined using an independent-sample *t*-test and one-way ANOVA. The *t*-test was used to examine whether there is a significant difference between male and female respondents with regard to their preferences. For all other socio-demographic variables, one-way ANOVA was used to test for significance of differences. The results are presented in Table 6. The choice of the respondents in favour of the dual-purpose chicken was positively influenced by the factors: female gender, high education, and high income ($P < 0.05$). Accepting the current situation of killing day-old chicks was less favoured by women, and genetic modification was more favoured by respondents with a higher education and respondents with a higher income ($P < 0.05$). All other social demographic characteristics (age, urbanisation, responsibility [or not] for children, geographic area or family size) had no significant relation with the choices of the respondents.

Considerations, reasons and arguments

The respondents were asked to indicate which reasons were important for their choices and considerations. To this end, they were provided with seven notions, which had been mentioned frequently in the focus groups. These were: 'animal-friendliness'; 'naturalness'; 'food security'; 'moral considerations'; 'feasibility'; 'males used as animal feed'; and 'costs'. For each notion an indication could be given as to its importance in making choices. Animal-friendliness scored high, followed by 'naturalness' and 'food security' (Table 7). In the survey, it was also asked whether one would be willing to pay more for eggs and poultry meat. This willing-

Table 5 Top five first preferences for the alternatives.

Alternative	Respondents
Look into the fresh egg and not incubate the male eggs	25%
Dual-purpose chicken	24%
Influencing the chicken by environmental factors such that fewer male eggs are laid	14%
Accepting the current practice of killing	14%
Change the chicken by genetic modification to facilitate sexing of freshly laid eggs	10%

ness to pay was related to the alternative one had chosen. Approximately 10–15% of the respondents were unwilling to pay more for their preferred alternative, 50–60% of the people declared to be willing to pay 5 to 10 eurocents extra for an egg, if their preferred option would be applied, and 15–30% said that they would be willing to pay double the price or more. From the respondents who preferred the dual-purpose chicken, approximately 40% indicated the willingness to pay the corresponding premium.

Discussion

This study revealed that lay people are readily able to think and talk about the issue of killing day-old chicks on the basis of even limited information, although more information would have been appreciated and would have helped develop a more considered judgement about the issue. The participants in the focus groups and the public survey stated that the provision of information by means of a documentary film was helpful. This type of visual information makes complex issues, such as the killing of day-old chicks, comprehensible and therefore open for discussion.

The issue of killing day-old chicks and possible technological alternatives to current practices in egg production is not only complex for lay people but also for experts, since only

Table 6 The relationship between the first choice of the respondents and their demographic characteristics.

Alternatives	Gender t-value	Education F-value	Personal wealth F-value
Less specialised chickens so that the males can be used for meat production ('dual-purpose chicken')	Women more*	High education more*	High income more*
Examine samples from freshly laid eggs to sex the eggs and not incubate male eggs			
Accepting the current practice of killing	Women less*		
Influencing the chicken by environmental factors, such that fewer male eggs are laid			
Influencing the chicken by genetic modification to facilitate sexing of freshly laid eggs		High education more*	High income more*

* $P < 0.05$ (t-tests and F-tests).

Table 7 Mean (\pm SD) scores on a 7-point scale ($n = 1,199$) for the reasons behind preferences for alternatives, in diminishing order.

Reason	Score*
Animal friendliness	5.98 (\pm 1.36)
Naturalness	5.38 (\pm 1.57)
Food safety	5.34 (\pm 1.61)
Moral considerations	4.55 (\pm 1.58)
Feasibility	4.43 (\pm 1.60)
Males used as animal feed	3.54 (\pm 1.73)
Costs	3.37 (\pm 1.73)

* All differences between scores are significant ($P < 0.05$, paired t-tests), except between moral considerations and feasibility ($P < 0.1$) and between naturalness and food safety (ns).

limited information is currently available about the various potential technological alternatives and their feasibility, costs and impacts upon animals. This implies that this study needs to be considered as a first exploration to support opinion formation about the issue, while acknowledging the tentative nature of its results. When more information becomes available about feasibility, costs and impacts of the alternatives, it is quite possible that judgements about these alternatives may change. Nevertheless, the current study already reveals that although lay people are largely ignorant about the current practice of killing day-old chicks, they find these practices rather discomfiting once informed about them. It therefore seems wise to conduct further studies about the feasibility, costs and impacts of the technological alternatives, and to accompany these studies with further monitoring and evaluation of their societal acceptability.

Neither the focus groups nor the public survey revealed a clear 'best choice' with regard to societal acceptability of the presented technological alternatives to killing one-day-old chicks. The societal acceptability of some of the alterna-

tives was however clearly seen as quite low. Killing embryos, in general, was not considered to be much more acceptable than killing day-old chicks. Killing late embryos, in particular, was not considered much of an alternative to current practices. Applying genetic modification was highly controversial, but acceptability depended on the specific type of application. Genetic modification used to enable sexing of freshly laid eggs seemed more acceptable than, for instance, genetic modification used to change male into female chicks ('sex reversal'), or to cause the death of male embryos during development. The study indicated that most people would support the pursuit of technological alternatives, and the technological alternatives that seem to qualify best for further studies are: i) looking into the fresh egg (to determine the sex of the egg and not incubate male eggs); ii) influencing the laying hens such that they produce fewer male eggs; and iii) using genetic modification to facilitate sexing fresh eggs. In addition, further exploration of the feasibility of a dual-purpose chicken is warranted.

The fact that, on average, females differed from males in their judgments confirms the findings of Evans and Miele (2007). Evans and Miele also found differences in judgment between people from the city and from the countryside. In our study we did not find any such differences. It might be that in the quite densely populated Netherlands, differences between respondents from the city and from the countryside are smaller than in less densely populated countries.

Respondents indicated that animal-friendliness was most important for their judgment of alternatives. Animal welfare issues should be part of the discussions on alternatives for killing day-olds. Killing day-old chicks is more an ethical discussion than an animal welfare discussion, provided killing is carried out appropriately. However, alternatives to killing day-olds (eg influencing the hen by environmental measures, genetic modification, dual-purpose chickens) may have positive or negative welfare implications. These welfare implications have to be examined and taken into account for alternatives of killing day-old males.

Further monitoring and evaluation of the societal acceptability of technological alternatives to the killing of day-old chicks should acknowledge that discussion about this issue

could be framed in two different ways. The alternatives to killing day-old chicks could be discussed while either accepting the current framework of the poultry sector or challenging this very framework. The first framing leads towards a discussion about improving one aspect of current poultry practice, while the second sees this particular aspect as but one expression of broader concerns regarding intensive poultry production that need to be included in the discussion. Further studies into societal acceptability should therefore start by unlocking the most appropriate framing for discussions about alternatives to killing day-old chicks.

The evaluative workshop with stakeholders and ethicists about the preliminary results of this study indicated that the framing of the discussion about alternatives to killing day-old chicks is also an important determinant for the societal preferences for certain alternatives, ie the dual-purpose chicken. If the current framework of the poultry sector is accepted, the development of a technological alternative would be an adequate response to the problematic aspect of killing day-old chicks. If, however, this current framework is not accepted but challenged, the development of a dual-purpose chicken would seem to be a more preferred solution in terms of broader concerns about animal welfare in poultry production.

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