



Original Research Article

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## Likelihood of Consuming Cloned Animal Products: Ordered Logistic Regression Model

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### A B S T R A C T

The use of novel food technologies like genetic modification technology, nanotechnology and food irradiation technology have received mixed responses from the public. But there is limited information available about consumers' attitudes toward food derived from cattle clones, when compared to what is known about consumers' responses to genetically modified food in general. In a survey conducted by the International Food Information Council (IFIC), 2007, in US, 49 per cent of consumers had a likelihood of purchasing foods from the offspring of cloned animals if determined safe by the FDA, while in China, a net 66 per cent of the consumers preferred to buy GM food if they were more nutritious. The objective was framed to investigate the various factors influencing the likelihood of researchers to consume cloned animal products, with the aim to develop a statistical model for predicting their acceptance decision. The salient findings of the study was found that the consumers used to prefer environment friendly cloned product, followed by price 10 percent lesser to traditional ones and availability in RTS type of product. Hence while formulating policies regarding purchasing of cloned animal products, the significant variables should be given importance meat from cloned animals, lesser price, such as products should indicate the ingredients, environmentally friendly, higher nutrient value, free from chemicals and safe to eat.

#### Keywords

gender, type of family, religion and family background

#### Article Info

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### Introduction

The use of novel food technologies like genetic modification technology, nanotechnology and food irradiation technology have received mixed responses from the public. Despite the US Food and Drug Administration (FDA) approval in principle of cloned animal products as they are no different from the conventionally bred

animals, in practice, consumers felt uneasy in purchasing such products (Aizakhi *et al.*, 2004; Brooks and Lusk, 2010; Butler *et al.*, 2008, Lusk and Marette, 2010; Aizakhi *et al.*, 2011). Food being a constitutive of both cultural and individual identity (Gaskell, *et al.*), the likelihood of consuming such products is correlated with discrete features comprising individual characteristics, socio-demographic variables (gender, type of

family, religion and family background) and attitudinal variables (Aizakhi *et al.*, 2011).

There is limited information available about consumers' attitudes toward food derived from cattle clones, when compared to what is known about consumers' responses to genetically modified food in general. In a survey conducted by The International Food Information Council (IFIC), 2007, in US, 49 per cent of consumers had a likelihood of purchasing foods from the offspring of cloned animals if determined safe by the FDA, while in China, a net 66 per cent of the consumers preferred to buy GM foods if they were more nutritious (Environics, 2001). Several other studies show that the acceptance of GM foods was high in China (Huang *et al.*, 2006) though their preferences differed among commodities. In a survey conducted by the Gallup organization in Europe (2008) only 11 per cent of the respondents stated that they would buy meat or milk of the offsprings of the cloned animals, while majority (41 %) said that this was not likely to happen even if a trusted source approved the safety of such products. Similar results were obtained in the Pew study (2001) where 29 per cent of consumers indicated that they would purchase meat and milk from the offspring of cloned animals, while 35 per cent and 33 per cent indicated a negative attitude towards meat and milk from the offsprings of cloned animals, respectively. The findings of International Food Information Council (IFIC, 2005) revealed that 43 per cent of respondents indicated they would be "not at all likely to buy" products derived from clones, with a combined 34 per cent indicating they would be "likely" or "somewhat likely." When questioned about product derived from clone offspring, the results were largely similar with 37 per cent "not at all likely to buy" and a combined 39 per cent either "likely" or "somewhat likely." Later IFIC studies found slightly higher levels of acceptance of product

from clone offspring at 41 per cent in 2006, and 49 per cent in 2007 (IFIC, 2007).

A study of Brooks and Lusk (2011), highlighted that Americans may be more accepting of consuming cloned animal products than Europeans. Also participants were more likely to consume cloned products after learning that both the U.S. Food and Drug Administration and the European Food Safety Authority had stated that cloned animal products pose no safety risk. Further, factors such as purchase motivators, perception, knowledge of organic foods and health concerns (Millock *et al.*, 2004) determine the willingness of consumers to buy organic foods (Gracia and Magistris, 2007). This was further substantiated by the study conducted by Sosin and Richards in 2005, wherein the participants were asked about their willingness to buy meat or milk products from offsprings of cloned animals, to which their response was that they would consider buying, provided FDA certified that such products are safe to consume and it improved the nutritional quality of the milk and meat. Similar studies conducted on willingness to pay for cloned animal products revealed the adverse attitude of the consumers towards this technology (Brooks and Lusk, 2010; Jones, *et al.*, 2010; Kofi Britwun, 2013). Sunbelt Agricultural Exposition in 2009, Jones *et al.*, 2010 employed the logit choice model in determining the relationship between consumer WTP for clone-free labels and their demographic characteristics. Survey results showed that 59.46 per cent of respondents were willing to pay for clone-free label products. Demographic variables like gender and education accelerates participants WTP for clone-free labels. Females were 22 per cent more likely to pay for a label and respondents who were knowledgeable about cloning and who read labels were 2 per cent less likely to pay for labels. Age also assumed to play an important role in determining the willingness

to pay for cloned products, as young customers had a favourable orientation to food products from biotechnology (Faass and Lahr, 2007). Other variables such as opinions, attitudes and shopping habits tend to influence consumers' willingness to pay for cloned animal products (Britwum and Bernard, 2018).

## Materials and Methods

The objective was framed to investigate the various factors influencing the likelihood of researchers to consume cloned animal products, with the aim to develop a statistical model for predicting their acceptance decision. For the present study a combination of purposive and multi-stage random sampling was adopted to select the respondents for the study. Two ICAR Research Institutes and two State Veterinary Universities were selected respectively, of which ICAR-NDRI and TANUVASU have been purposively included as they are actively engaged in research on animal cloning. From each institute, 30 students (M.Sc/M.V.Sc/Ph.D) and 15 scientific faculties (Scientists/Professors) from Production, Processing and Management groups were randomly selected for the present study conducted during 2016-17. Data were collected through face to face interview using pretested interview schedule from 45 respondents from each university, thus comprising a sample of 180 respondents.

Likelihood to consume cloned animal products was studied using a schedule developed for the purpose with the score of 2, 1, 0 for likely, partially likely and unlikely, respectively. For further analysis, Ordered logistic regression model was used to identify those factors influencing likelihood of purchasing of cloned animal products. The advantage of ordered logistic is its ability to analyze a dependent variable that has more than two categories where the value between

each category has meaningful unobserved sequential order. Following, the ordered logistic has a general form of;

$$Y_i^* = \beta' X_i + \epsilon_i \quad i = 1, \dots, N \text{ respondents},$$

Where;  $Y_i^*$  is the underlying unobserved (latent) variable that indexes the level of Respondents likelihood

- i      Observation i.e. respondents
- $X_i$     Vector of explanatory variables
- $\beta$     Parameters to be estimated
- $\epsilon$     Error term

Since likelihood is an ordinal variable, the ordered logit was used to identify the factors (independent variables) like age, education, gender, family background, marital status, religion, family type, sources of information, issues facing by the society today and ethical issues, familiarity about animal cloning and the perception towards animal cloning. All the analyses were made using statistical software SPSS (Version 17 for Windows).

## Results and Discussion

### Socio-economic Profile of Respondents

Pooled data showed that more than half (67.92%) of the respondents were young age. Further, 73.75 percent of the respondents were male. More than half (56.95%) of the respondents were residing in rural areas (Parameswaranai, 2018). When come to religion aspect, 79.70 per cent were Hindus, 13.50 percent were Muslims, and 06.81 percent were belonging to other religions. 80.83 percent of respondents were unmarried. About three-fourth (72.50%) of the respondents were in nuclear family. In food habit, 60.00 per cent were non-vegetarians,

followed by 30.00 per cent were vegetarians, and 10.00 per cent were eggarians.

### Likelihood of purchasing of cloned animal products

The respondents were stratified into unlikely, partial likely, and likely of purchasing of cloned animal products. The total sample size for addressing this research objective was 180 respondents. Based on their probability proportional to size principle, sample size of

likelihood, partial likelihood and non-likelihood were determined. Thus, a sample size of 28, 94 and 58 partial likelihood, likelihood, and non-likelihood were included in the sample respondents, respectively.

Finally, from each stratum sample respondents were identified using simple random sampling technique. Based on literature and personal experience 11 variables were selected. The influencing variables were identified using ordinal logistic regression.

**Table.1**

| Institutes/Universities identified for the study               | States        |
|--|---------------|
| ICAR- National dairy Research Institute                        | Haryana       |
| ICAR-Indian Veterinary Research Institute                      | Uttar Pradesh |
| Karnataka Veterinary, Animal and Fisheries Science University  | Karnataka     |
| Tamil Nadu Veterinary, Animal and Fisheries Science University | Tamil Nadu    |

**Table.2** Model Fitting Information

| Model                  | -2 Log Likelihood | Chi-Square | Df | Sig.  |
|------------------------|-------------------|------------|----|-------|
| Intercept Only         | 352.914           |            |    |       |
| Final                  | 0.000             | 352.914    | 11 | 0.000 |
| <b>Goodness-of-Fit</b> |                   |            |    |       |
| Pearson                |                   | 8.062      | 93 | 1.000 |
| Deviance               |                   | 9.926      | 93 | 1.000 |

**Table.3** Pseudo R-Square

|               |              |
|---------------|--------------|
| Cox and Snell | <b>0.859</b> |
| Nagelkerke    | 0.996        |
| McFadden      | 0.987        |

**Table.4** Ordered logistic regression for factors influencing likelihood of purchasing of cloned animal products

|           | Threshold<br>Location/Factors                   | Estimate | Std.<br>Error | Wald   | Df | Sig.          | 95% Confidence<br>Interval |                |
|-----------|---|----------|---------------|--------|----|---------------|----------------------------|----------------|
|           | Value R <sup>2</sup> (0-1)                      |          |               |        |    |               | Lower<br>bound             | Upper<br>Bound |
|           | [category = 0]                                  | 171.010  | 49.689        | 11.845 | 1  | .001          | 73.623                     | 268.398        |
|           | [category = 1]                                  | 198.320  | 57.757        | 11.790 | 1  | .001          | 85.119                     | 311.521        |
| <b>1</b>  | Likely to buy meat from cloned animals          | 8.692    | 3.317         | 6.866  | 1  | <b>.009**</b> | 2.190                      | 15.194         |
| <b>2</b>  | Buy meat offspring                              | 5.124    | 3.232         | 2.513  | 1  | .113          | -1.211                     | 11.460         |
| <b>3</b>  | Price 10 per cent lesser than traditional foods | 8.611    | 2.780         | 9.596  | 1  | <b>.002**</b> | 3.163                      | 14.059         |
| <b>4</b>  | Display of ingredients                          | 8.648    | 3.100         | 7.782  | 1  | <b>.005**</b> | 2.572                      | 14.724         |
| <b>5</b>  | Quality product                                 | 4.663    | 3.774         | 1.527  | 1  | .217          | -2.733                     | 12.059         |
| <b>6</b>  | Environment friendly                            | 4.243    | 1.271         | 11.147 | 1  | <b>.001**</b> | 1.752                      | 6.734          |
| <b>7</b>  | Highly nutritious                               | 7.576    | 2.686         | 7.957  | 1  | <b>.005**</b> | 2.312                      | 12.840         |
| <b>8</b>  | Taste good                                      | 10.480   | 4.437         | 5.580  | 1  | .018          | 1.784                      | 19.176         |
| <b>9</b>  | Chemical free and safe                          | 6.083    | 2.769         | 4.825  | 1  | <b>.028*</b>  | .655                       | 11.510         |
| <b>10</b> | Labeled   | 2.406    | 2.165         | 1.235  | 1  | .266          | -1.837                     | 6.649          |
| <b>11</b> | RTS type  | 10.078   | 3.417         | 8.701  | 1  | <b>.003**</b> | 3.382                      | 16.775         |

\*\* significant at P<0.01 and \* significant at P<0.05

(Field survey, 2017)

The result of ordered logistic regression on likelihood of purchasing of cloned animal products is summarized in Table 1, 2 and 3. The ordered logistic regression model is estimated using maximum likelihood method. The  $\chi^2$  result shows that the parameters were significantly different from zero at P<0.01 for the likelihood of purchasing of cloned animal products (Table 1.1). The McFadden's R-square or Pseudo R<sup>2</sup> is 0.987, indicating that 98.70 per cent of the variations in probabilities of getting in high level of likelihood of purchasing of cloned animal products was explained by the selected explanatory variables (Table 1.2). Explanatory variables

that were taken to the model are the statements for the likelihood of purchasing of cloned animal products. Among 11 variables taken in the model six were found to be significant at 1 per cent level, one was found to be significant at 5 per cent level and four were found to be non-significant even at 10 per cent level (Table 1.3). Explanatory variables selected for econometric model were statistically significant and also self-explanatory in nature. As and when if government formulate policy regarding purchasing of cloned animal products, the significant variables should be given importance such as environmentally friendly, lesser price, ready-to-serve food type,

products should indicate the ingredients, higher nutrient value, likely to buy meat from cloned animals, and free from chemicals and safe to eat.

From the study it was found that the consumers used to prefer environment friendly cloned product, followed by price 10 per cent lesser to traditional ones and availability in RTS type of product. The economic and political benefits of comprehending customer's perceptions will be important to successfully placing the product in the market. These perceptions are checked over time as the political and media climate changes toward the technology and in addition find willingness to pay for cloned animals versus traditional ones. The government policies should consider the significant variables like meat from cloned animals, lesser price, such as products should indicate the ingredients, environmentally friendly, higher nutrient value, free from chemicals and safe to eat. Similar study could be repeated by selecting more number of respondents and more variables while covering larger number of consumers and general public.

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