# Kenyan perceptions of aflatoxin: An analysis of raw milk consumption

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# Outline

- Introduction
- Study area & data collection
- Methodology
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- Conclusions

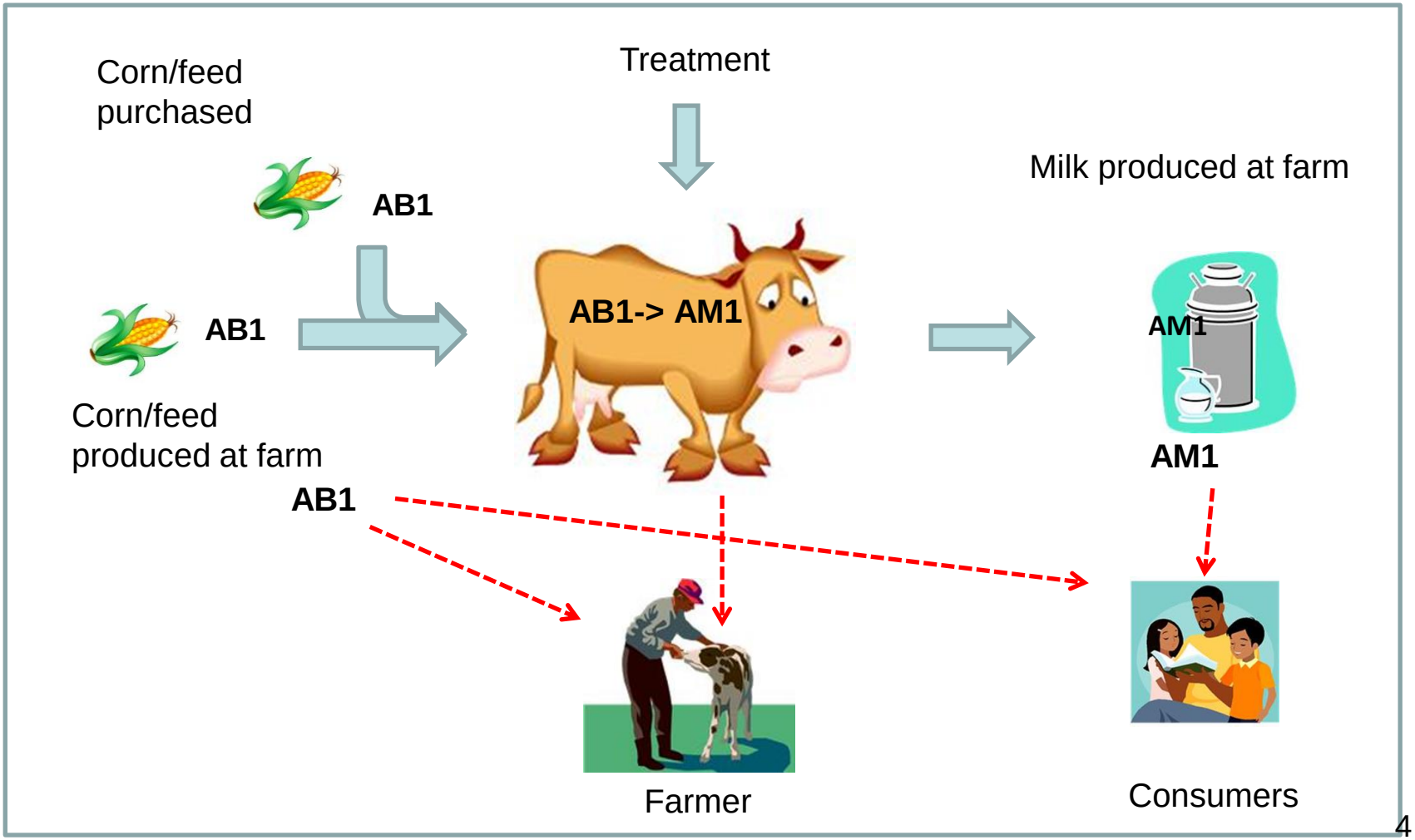
# Introduction

- Aflatoxins are mycotoxins produced by certain species of moulds, mainly *Aspergillus flavus* and *Aspergillus parasiticus*

- Aflatoxins can be transmitted to humans through agricultural products consumption

# Introduction

**Figure 1.** Aflatoxin contamination pathway



# Introduction

- Aflatoxins could be responsible for:
  - Hepatocellular carcinoma in humans
  - Stunting in children
  - Acute aflatoxin poisoning due to consumption of contaminated food causes deaths
  - Chronic aflatoxin poisoning in dairy cattle, causing a reduction in milk yield
  - Decreased feed efficiency
  - Reduced reproduction efficiency

# Introduction

- There are no accurate estimates of incidence of chronic and acute disease related to aflatoxin exposure

- Outbreaks in Kenya (1982, 2001, 2004 and 2005) and Somalia (1997/98) indicate the magnitude of the problem

- The 2004 outbreak in Kenya was responsible for 317 cases and 125 deaths

# Introduction

- Kenya has among the highest milk consumption levels of developing countries (100 kg/year per capita vs. 25kg for sub-Saharan Africa)

- Around 80% of the marketed milk is sold raw and mainly through the informal market

- Research questions:

  - Are consumers aware about aflatoxins and possible milk contamination?

  - Are consumers willing to pay (WTP) for certified ‘aflatoxin-free’ milk?

# Study area & data collection

- City of Nairobi, Kenya
- 1 area:
  - Dagoretti: peri-urban area of Nairobi ➡ low-income class respondents; raw milk consumers (323 participants)
- Sampling: systematic sampling - assumptions of randomness over time
- Face-to-face interviews conducted in July and August 2013

# Study area & data collection

- Face-to-face questionnaire: 
  - Directed at raw milk consumers

- Questionnaire included different sections:
  - Milk purchase and consumption habits
  - Aflatoxin awareness
  - Choice experiment exercise
  - Attitudinal issues
  - Socio-demographic characteristics

# Methodology

- We opted for Choice Experiment (CE) or more precisely Best-Worst (B-W) technique

- The selection of the milk attributes to design the experiment was on the basis of:
  - Research objectives
  - Review of literature and previous works
  - Respondents' ability to process the information

# Methodology

**Table 1.** Selected raw milk attributes and their respective levels

| Attributes | Levels |
|---|---|
| Milk colour | White |
| | Yellowish |
| Milk smell | Not smelly |
| | Smelly |
| Aflatoxin certification | Certified retailer |
| | Non-certified retailer |
| Price* (KSH/Litre) | 50 |
| | 60 |
| | 70 |
| | 80 |

*1 Euro = 120 KSH (May 2014)

# Methodology

- Raw milk attributes: $2^3.4 = 32$ different products

- Orthogonal fractional factorial design (OMP) to reduce the number of products

- OMP ➡ reduce the number of choice cards to 8 (first alternative)

  ➡ Using two generators we produced the 2 remaining alternatives

# Methodology

**Figure 2.** An example of a choice experiment card for the raw milk questionnaire

**Card 5**

Please indicate the most preferred cow milk and the least preferred cow milk
(Tick only one case in each line)

| | Milk 1 | Milk 2 | Milk 3 |
|---|---|---|---|
| | White | White | Yellowish |
| | Not smelly | Not smelly | Smelly |
| | Aflatoxin-free certified | Non-certified | Aflatoxin-free certified |
| | 70 KSH/litre | 50 KSH/litre | 80 KSH/litre |
| Most preferred | ☐ | ☐ | ☐ |
| Least preferred | ☐ | ☐ | ☐ |

# Methodology

- Conjoint analysis arises from the theory of Lancaster (1966) which stipulates that utility is derived from the properties or characteristics that goods possess (bundle of attributes)

Consumer's utility could be expressed as:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \quad (1)$$

Lancaster theory leads to the following linear additive decomposition of $V_{ij}$:

$$V_{ij} = \beta_1 x_{ij1} + \beta_2 x_{ij2} + \ldots + \beta_n x_{ijn} \quad (2)$$

$x_{ijn}$ is the $n^{th}$ attribute value for card j for consumer i, and $\beta_n$ represents the coefficients to be estimated

# Methodology

- Following additional assumptions about the distribution of the error term, the following probability models could be derived:

✓ CL (McFadden, 1973):

$$Pr(j) = \frac{e^{V_{ij}}}{\sum_{k \in C_n} e^{V_{ik}}} \quad (3)$$

✓ RPL model (Train, 2009):

$$Pr(i) = \int \left(\frac{e^{\beta' . X_{ni}}}{\sum_j e^{\beta' . X_{nj}}}\right) . f(\beta) . d\beta \quad (4)$$

where $f(\beta)$ is the density function of $\beta$

# Methodology

- Consumers' willingness to pay (WTP) in preference space was obtained as follows:

$$WTP_i = -\frac{\beta_i}{\beta_{price}} \quad (5)$$

$\beta_i$ : coefficient of the attribute level

$\beta_{price}$ : coefficient of the price attribute

- Consumers' willingness to pay (WTP) in WTP space was obtained by estimating a Generalized Multinomial Logit model (G-MNL) fixing $\theta = \tau = 0$ (Hensher and Green 2010; Hole 2011)

# Results

**Table 2.** Respondents' characteristics

| Characteristic | Characteristic level | (%) |
|---|---|---|
| **Age** | ≤ 20 | 6 |
| | 21-30 | 50 |
| | 31-40 | 28 |
| | 41 and older | 16 |
| **Marital Status** | Single | 40 |
| | Married | 56 |
| | Divorced | 3 |
| | Widow | 1 |
| **Members of Households** | One | 14 |
| | Two | 19 |
| | Three | 22 |
| | Four | 20 |
| | Five | 18 |
| | More than five | 7 |

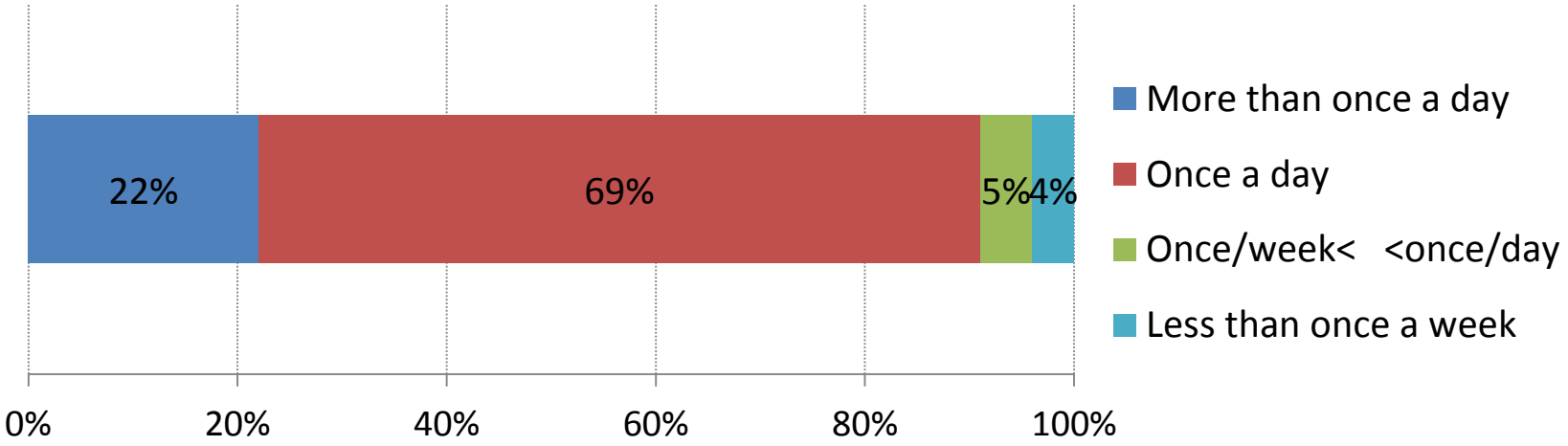
# Results

**Table 2.** Respondents' characteristics (contd.)

| Characteristic | Characteristic level | (%) |
|---|---|---|
| **Children living in the household** | No children | 33 |
| | One child | 26 |
| | Two children | 24 |
| | Three children | 14 |
| | Four children and more | 3 |
| **Education** | No education | 1 |
| | Primary | 23 |
| | Secondary | 49 |
| | College | 21 |
| | University | 6 |

# Results

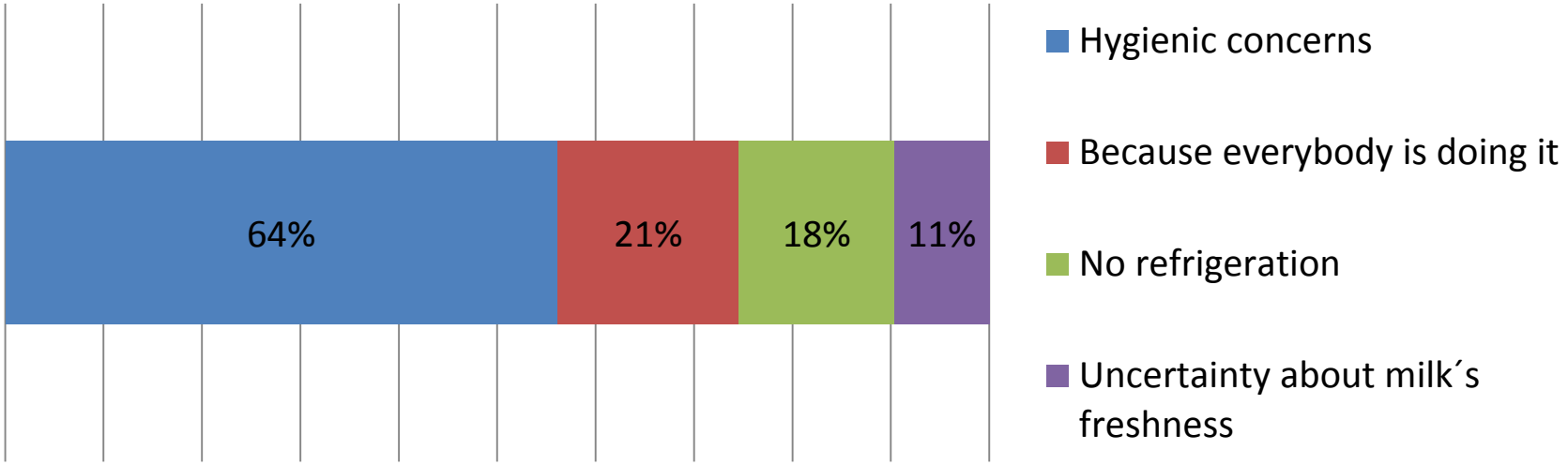
**Figure 3.** Raw milk purchase frequency



# Results

- Almost all respondents (99%) boil the milk prior to consumption

**Figure 4.** Reasons for boiling the milk




- Majority of respondents (95%) believe that the milk is safe after boiling

# Results

**Figure 5.** Have you heard about aflatoxin?

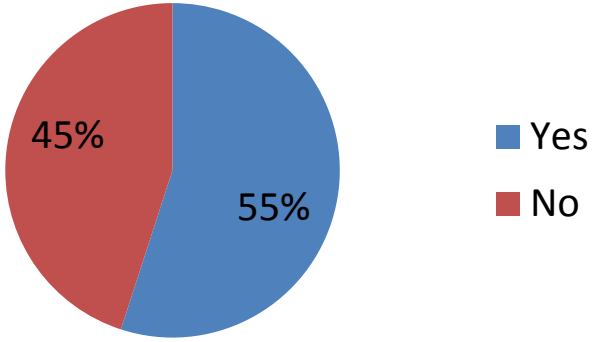
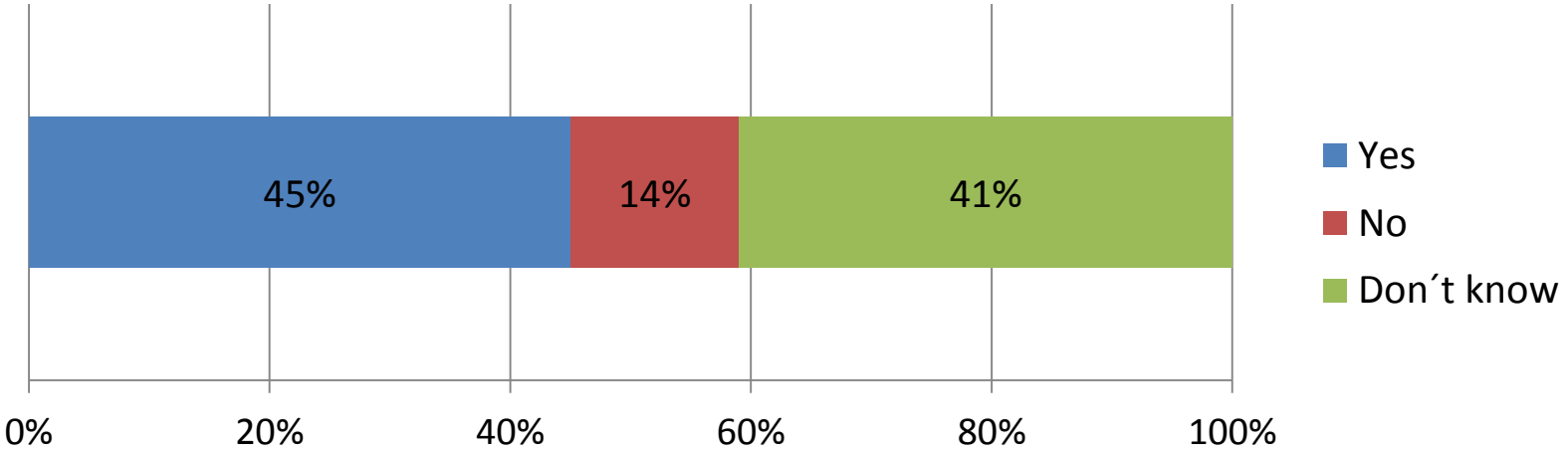



**Figure 6.** Can aflatoxins be transferred from mouldy feed given to a cow into milk?



# Results

**Figure 7.** Health impact of aflatoxin on humans

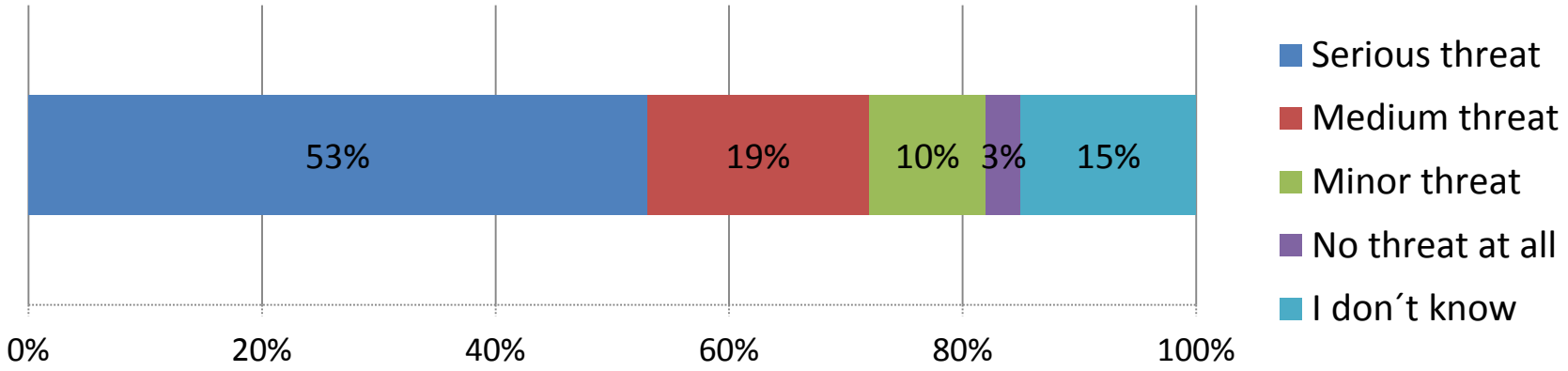
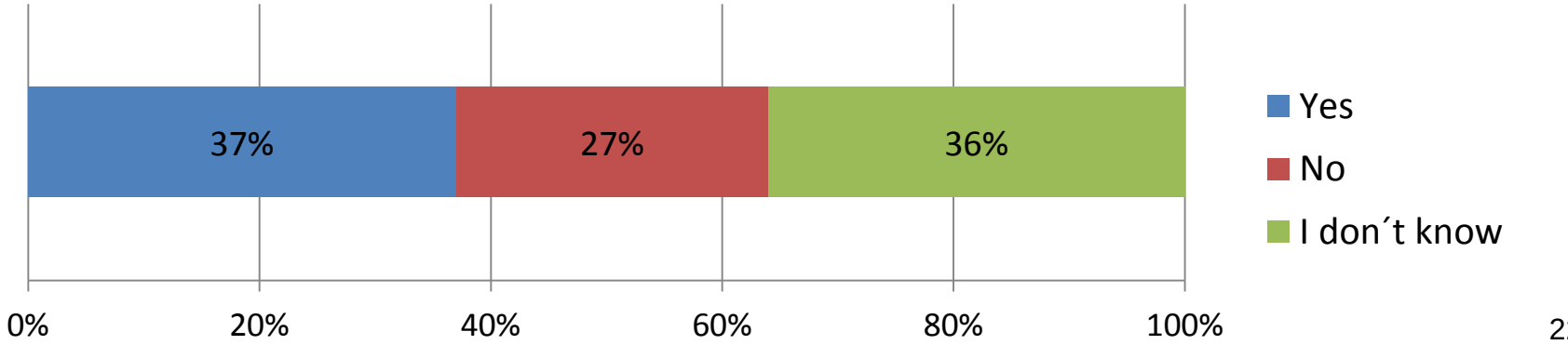



**Figure 8.** Is it possible to make aflatoxin contaminated milk safe?



# Results

**Figure 9.** Opinion on food certificate/food safety labels?

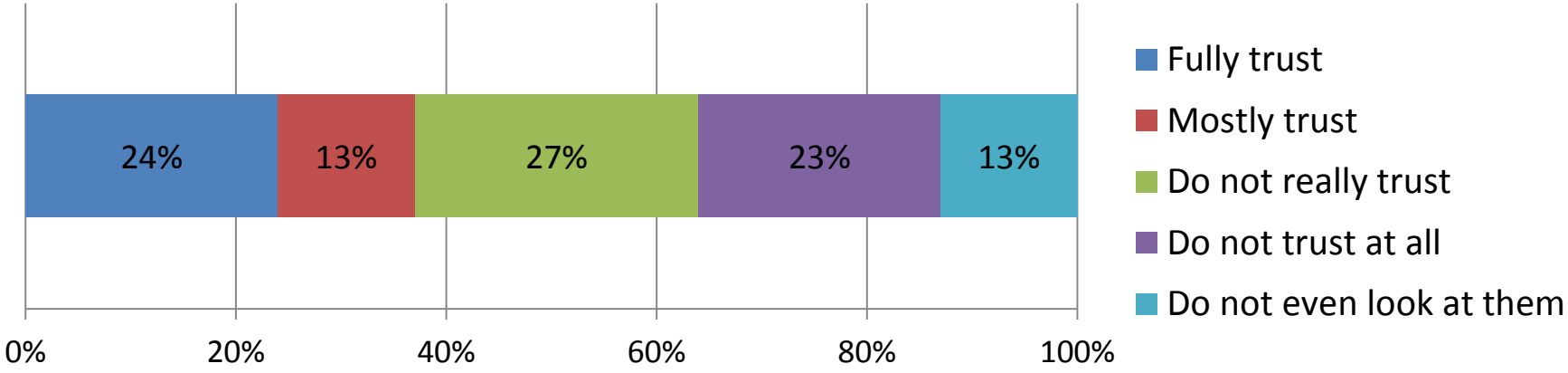
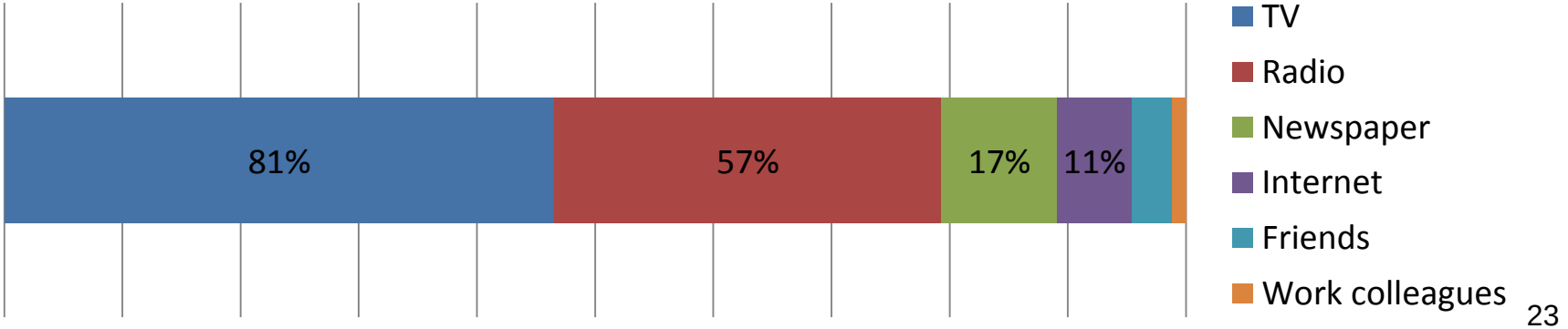



**Figure 10.** Main sources of information*



# Results

**Table 3.** Estimated models' coefficients for raw milk survey respondents

| Variable | CL | RPL |
|---|---|---|
| White[a] | .3567*** | . 6563*** |
| Smelly[b] | -1.8465*** | -5. 6716*** |
| Certified[c] | 1.7593*** | 4.4568*** |
| Price | -.0301*** | -.0643*** |
| SD_White | | 1.1018 *** |
| SD_Smelly | | -4.0607*** |
| SD_Certified | | 3.5125*** |
| SD_Price | | 0.0954*** |
| LL | -1980.1*** | -1600.9*** |
| Pseudo $R^2$ | 0.1998 | |

[a] Dummy variable takes 1 when the milk is white and 0 when it is yellowish.
[b] Dummy variable takes 1 when the milk is smelly and 0 when it is not smelly.
[c] Dummy variable takes 1 when the milk is certified and 0 when it is non-certified.
***Significant at 1%.

# Results

**Table 4.** Willingness to pay (WTP) estimates (in KSH/litre) and 95% confidence intervals (CI) for raw milk survey respondents

| | **CL** | **RPL** |
|---|---|---|
| **Variable** | WTP [95% CI] | WTP [95% CI] |
| White | 11.8 [7.3; 16.8] | 10.2 [5.9; 15.3 ] |
| Not smelly | 61.2 [53.4; 71.6] | 88.1 [71.4; 111.6] |
| Certified | 58.4 [50.0; 69.6] | 69.3 [55.3; 89.2] |

# Results

**Table 5.** RPL model willingness to pay (WTP) estimates (in KSH/litre) and 95% confidence intervals (CI) for certified 'aflatoxin-free' milk

| Groups | WTP [95% CI] |
|---|---|
| **All sample** | 69.3 [55.3; 89.2] |
| **Heard about aflatoxin** | 73.0 [55.7; 102.4] |
| **Have not heard about aflatoxin** | 66.4 [47.6; 99.5] |
| **Aflatoxin can be transferred** | 154.3 [96.3; 370.7] |
| **It can't be transferred or I don't know** | 45.6 [36.8; 57.4] |

# Results

**Table 6.** Willingness to pay (WTP) estimates (in KSH/litre) and 95% confidence intervals (CI) for raw milk survey respondents: *preference space vs. WTP space*

| | **RPL preference space** | **RPL WTP space** |
|---|---|---|
| | [95% CI] | [95% CI] |
| **Variable** | | |
| White | 10.2 | 5.2 |
| | [5.9; 15.3 ] (2.5) | [1.8; 8.5] (1.72) |
| Not smelly | 88.1 | 67.8 |
| | [71.4; 111.6] (10.1) | [57.1; 78.4] (5.44) |
| Certified | 69.3 | 58.2 |
| | [55.3; 89.2] (7.80) | [47.4; 69.1] (5.53) |

# Conclusions

- Surprisingly, milk consumers/buyers' awareness about aflatoxin is relatively high in peri-urban areas (55%)

- Insufficient knowledge of respondents on the health risks of aflatoxin and if it can be transferred to milk ➡ importance to enhance population understanding (communication, TV, radio)

- A high proportion of respondents believe that boiling the milk will eliminate aflatoxin from the milk (which is wrong)

# Conclusions

- Respondents are willing to pay a premium for certified 'aflatoxin-free' milk ➡ These results are of value to the dairy industry in the design and implementation of the necessary actions to improve the quality of the product (certification? trust?)

- Respondents' WTP depends on their awareness about aflatoxin and its presence in milk ➡ higher awareness implies higher premium

- RPL model is the best suited (among the other studied models: CL, OL, ROL)

- Next steps: GMNL model – WTP space – correlation among variables

# Acknowledgement

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# Thanks

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