Pork production with entire males and immunocastrates in South America

COST Action IPEMA Symposium
EAAP 69th annual meeting, Dubrovnik 2018


CONTEGRAL
aliar
Colombia
Ecuador
PRONACA
Redondos
RICOPOLLO
Peru
COCYCA S.R.
CAMPO NOBLE
AGROSUPER
Chile
Uruguay
PALADINI
Argentina
aurora
Pamplona
Sulita
Adelle
Sadia
Frimesa
Brazil

THE BRAZILIAN PIG MEAT INDUSTRY

Facts and figures

- Approaching 44,000,000 pigs harvested / year or 174,600 per working day in 2018
- Pork production is mostly verticalized and it is becoming highly concentrated
- Only two Companies (*BRF* and *JBS*) are responsible for nearly half of the total output
- Some of the pork production systems have also poultry in 100% vertical operations
- Large and mid- size Cooperatives (*Aurora* and *Frimesa*) are important players in the domestic market and exports

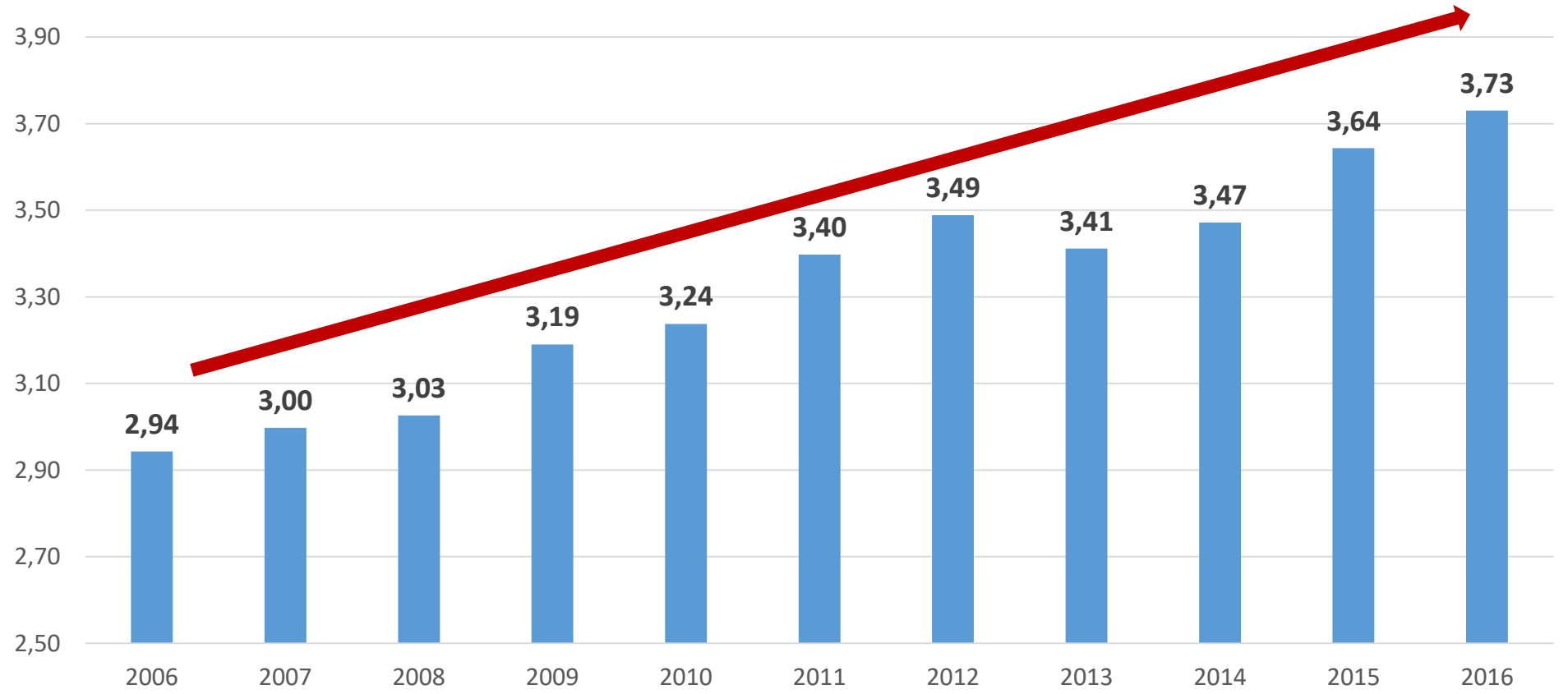
INDUSTRY STRUCTURE

- BRAZIL HAS 117 PACKING PLANTS UNDER FEDERAL MEAT INSPECTION (CONSIDERING JUST PIGS)
- SLAUGHTER CAPACITY AROUND 180,000 PIGS/DAY, RISING TO 200,000 PIGS/DAY

The whole country is free of:
PRRS (Porcine Reproductive and Respiratory Syndrome),
PED (Porcine Epidemic Diarrhea) and
TGE (Transmissible Gastro-Enteritis)

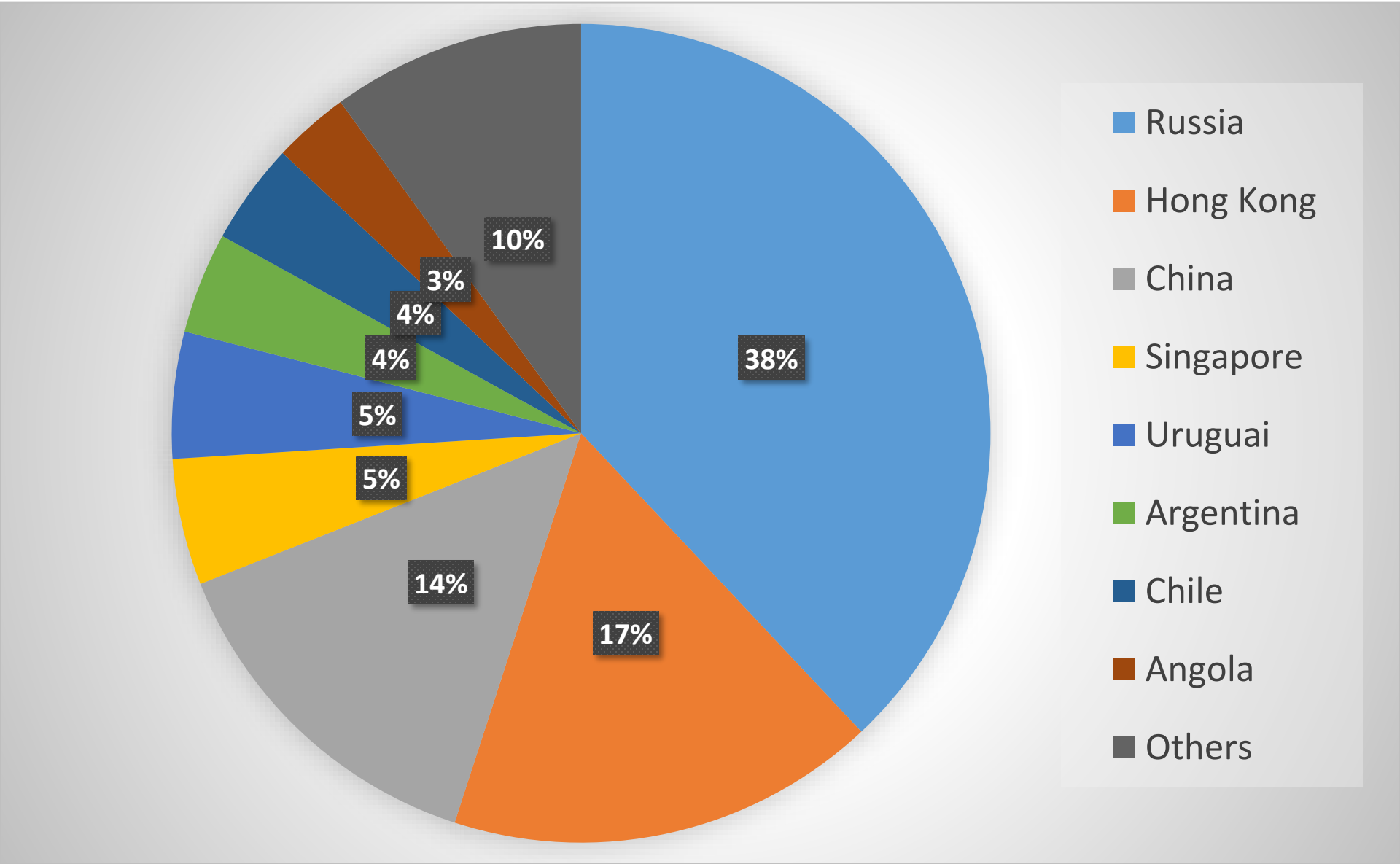
Major pork producing states are free of Foot and Mouth Disease (FMD) with vaccination
One state (Santa Catarina) is free of FMD without vaccination

PORK PRODUCTION (MILLION TONS)



SOURCE: ABPA

PORK EXPORTS DESTINATION (2017)



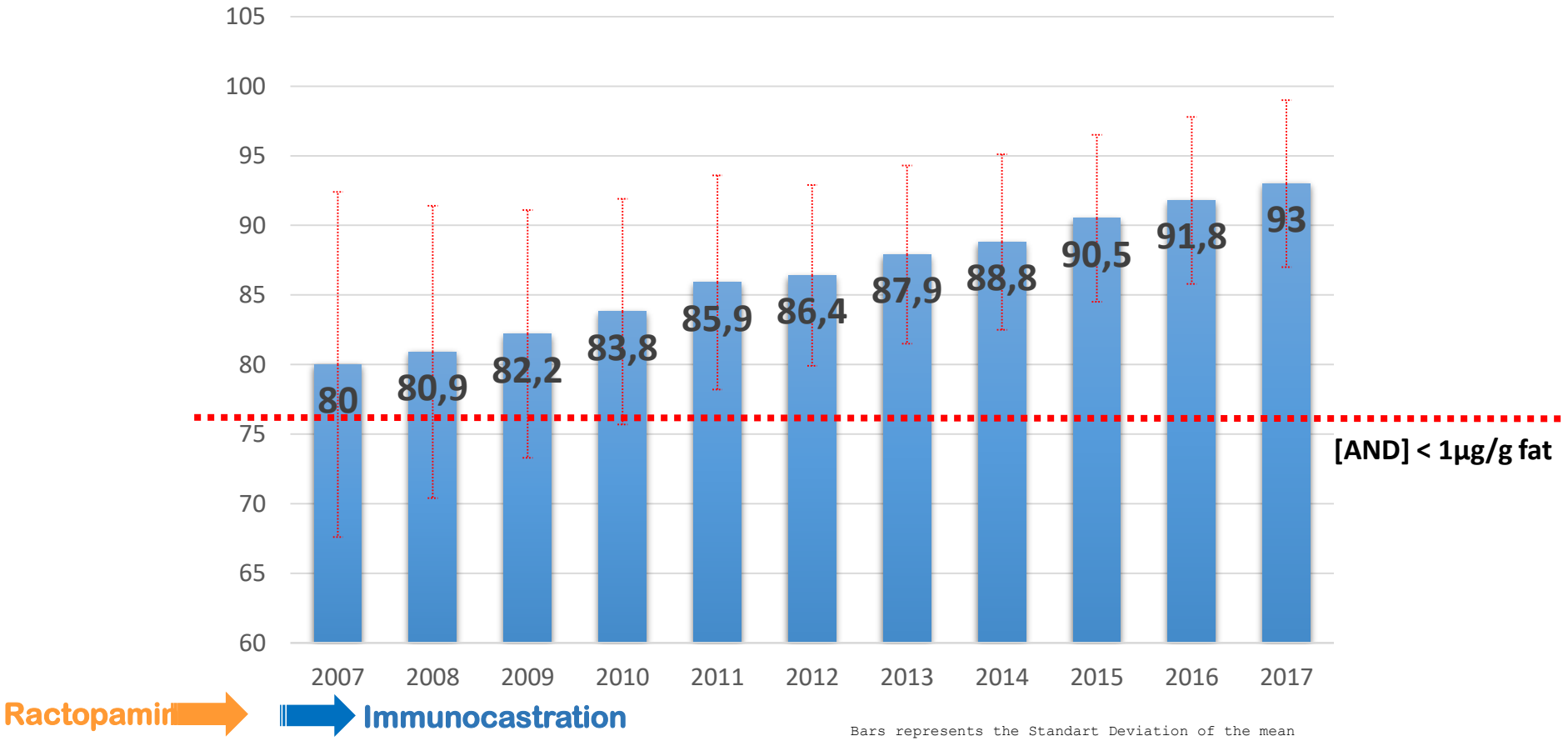
After seven years of negotiation, the Japanese Government has authorized in 2014 the import of Brazilian pork from eight plants all of which are from the State of Santa Catarina.

Processed and fresh pork are almost 100% branded

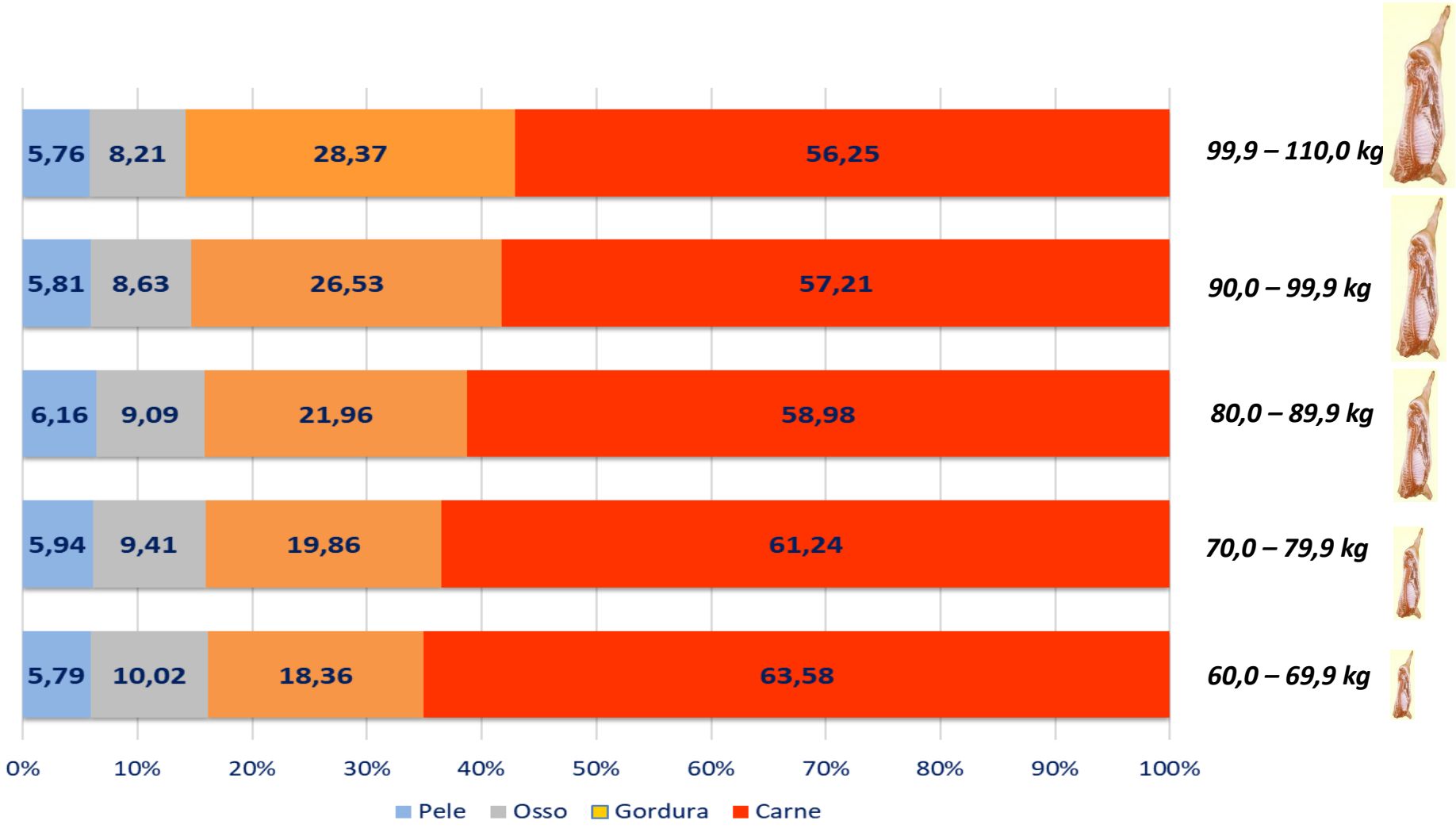
At the markets shelves...

80% further processed produtcs – 20% fresh pork with MAT or frozen pork

Average hot carcass weight (Kg ± SD) in the Brazilian pork industry



Cold carcass composition (%)



Heavy pigs

Items	Marketing wt, kg					
	125	130	135	140	145	150
Floor space/pig[1], m^2	0.84	0.86	0.89	0.91	0.93	0.95
Feeder space[2], cm	34.6	35.1	35.5	36.0	36.4	36.8
Drinker height, cm						
Right-angled waterer[3]	73.8	74.8	75.7	76.6	77.5	78.4
Downward waterer[4]	88.6	89.7	90.8	91.9	93.0	94.1
Heat production[5], kcal/h	242.1	248.1	254.0	259.7	265.5	271.1
Pigs/truck[6]	163	156	151	145	140	136
Truck space/pig[7], m^2	0.43	0.44	0.45	0.47	0.48	0.50

(Wu et al., 2017)

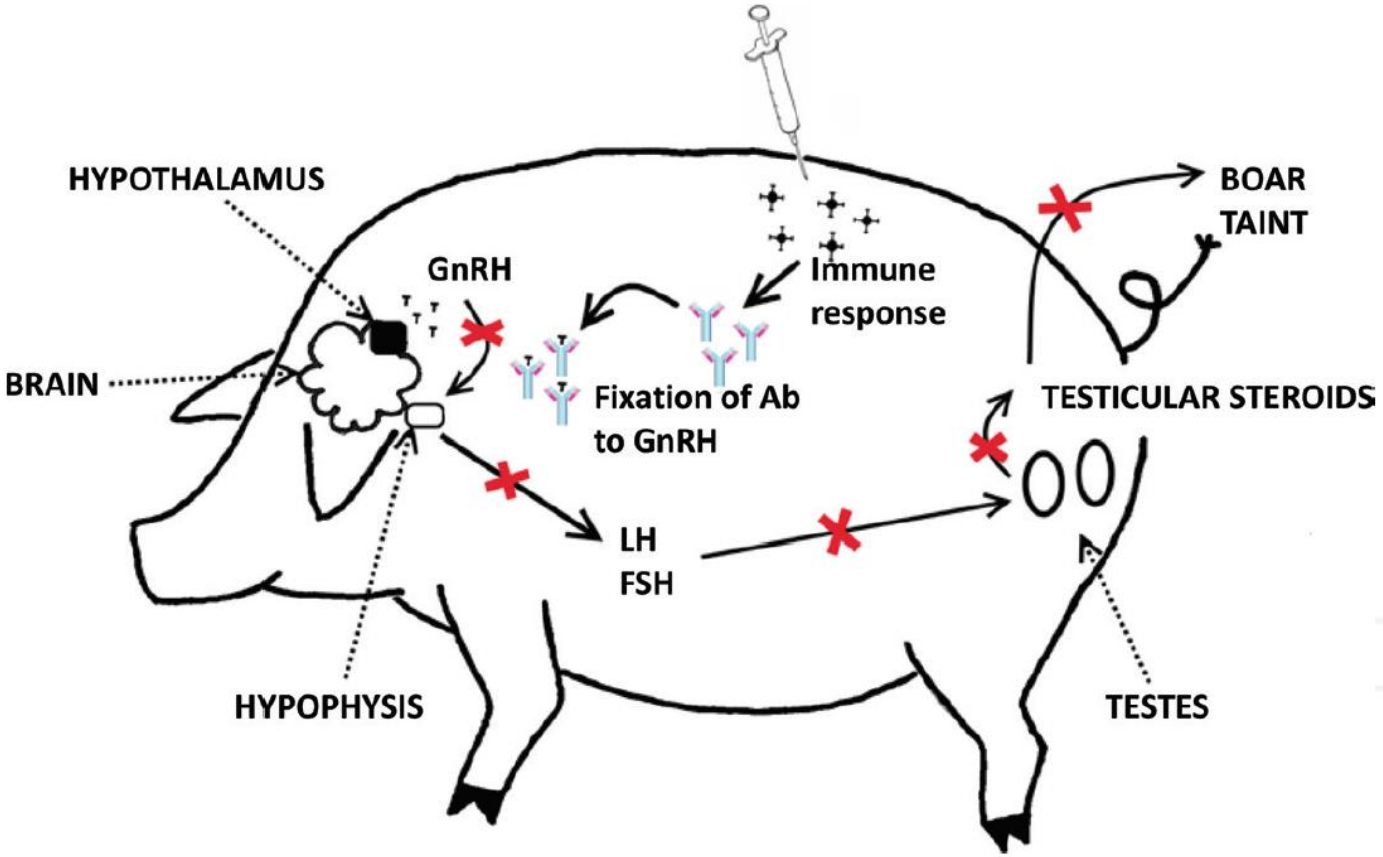


Figure 3. Physiological response to immunocastration in male pigs. The vaccine consists of the antigen (GnRH analogue that is bind to carrier protein), which triggers the immune system to produce antibodies that neutralise endogenous GnRH. Consequently, there is no stimulus for the hypophysis to release LH and FSH hormones, which in turn fails to signal the testes to produce testosterone and androstenone and thus prevents boar taint development.

(Čandek-Potokar et al., 2017)

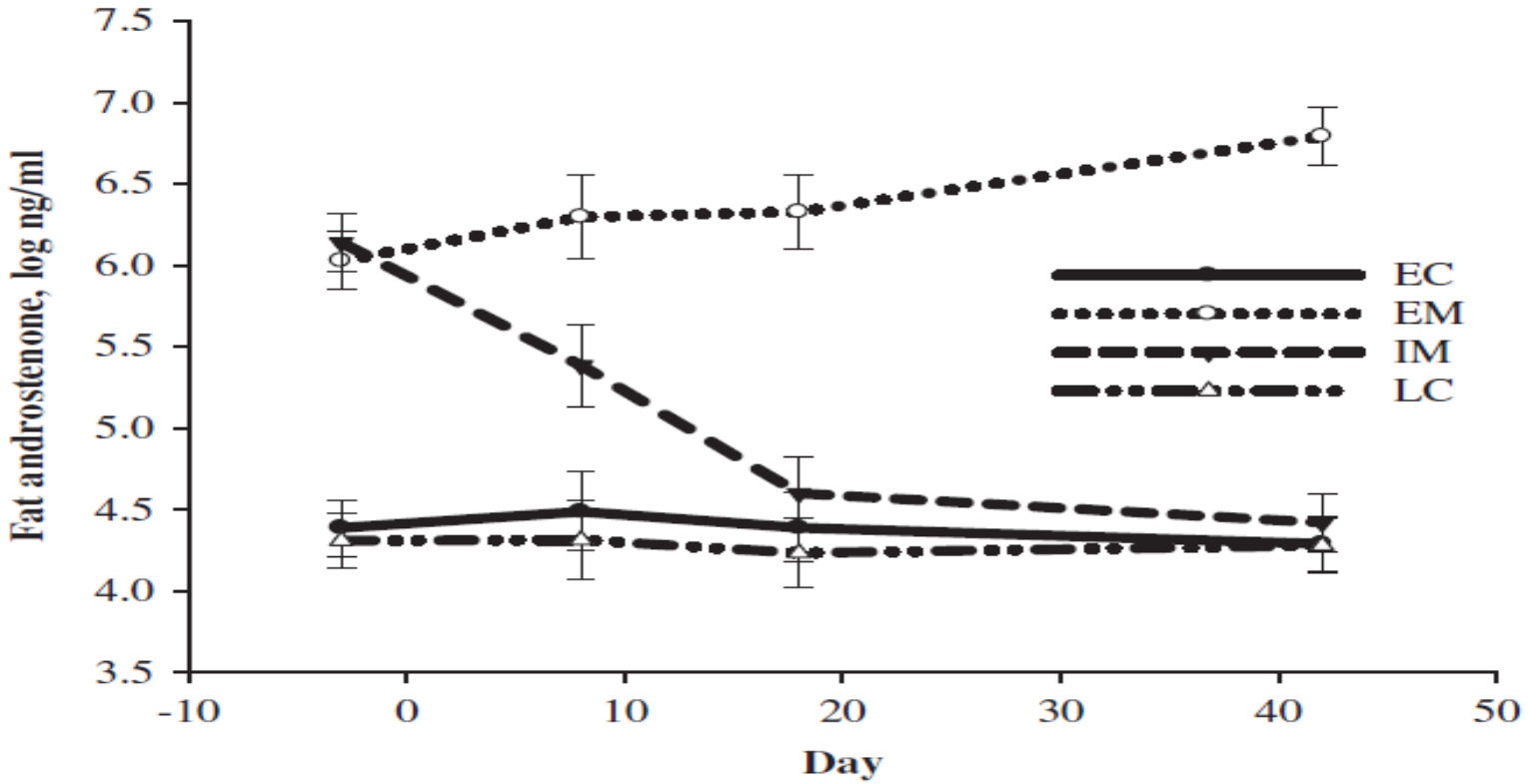


Figure 1 Androstenone concentrations in back fat of early castrates (EC), entire male pigs (EM), immunized male pigs (IM) and late castrates (LC) across days relative to administering the booster dose of gonadotropin-releasing hormone (GnRH) analog (day 0; 14 weeks of age) to IM. EC: male pigs surgically castrated within 4 days after birth; IM: EM immunized GnRH at 30 and 70 kg BW (8 and 14 weeks of age, respectively); LC: male pigs surgically castrated between 25 and 40 kg BW (10 weeks of age).

(Huber et al., 2018)

Facts and figures on Brazil

- **Entires males are not welcome by the local pork industry**

- **Physical castration of male piglets has been practised since the beginning of industrial pork production, during the early 1940s.**

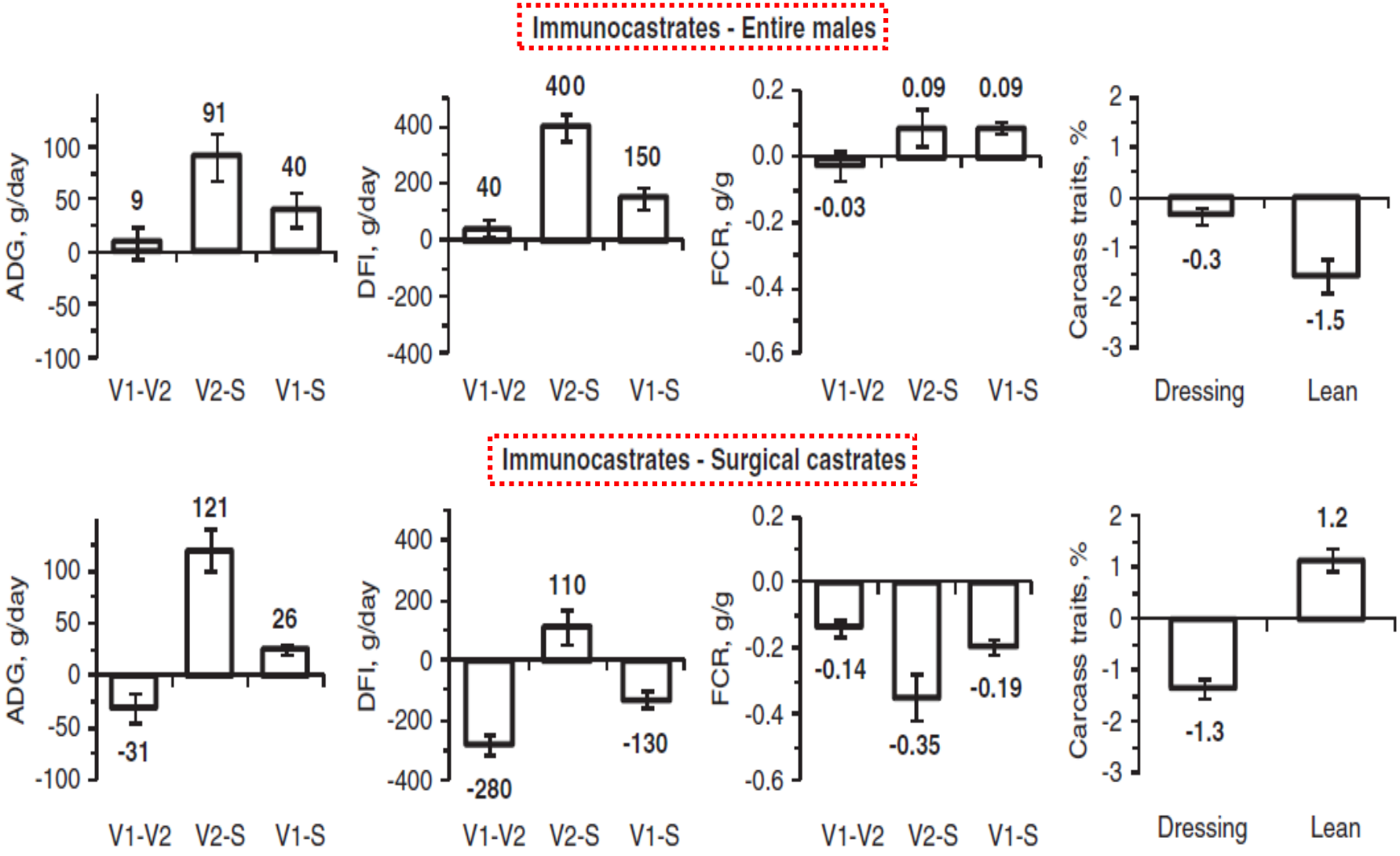
- **In the processors minds: One “tainted” product is too much. Boars are a threat to our pork brand.**

- **Federal Meat Inspection Service places limitations on the intentional processing of boar carcasses and Quality Assurance teams don´t like to run hundreds of “boar taint” tests.**

- **Welfare and economic pushes! Boars are welcome as long as their [AND] < 1.0 µg/g in backfat or bellyfat.**

In Brazil 60% of the entire males pigs are vaccinated against GnRH or 13,200,000 pigs/year

Meta-analysis



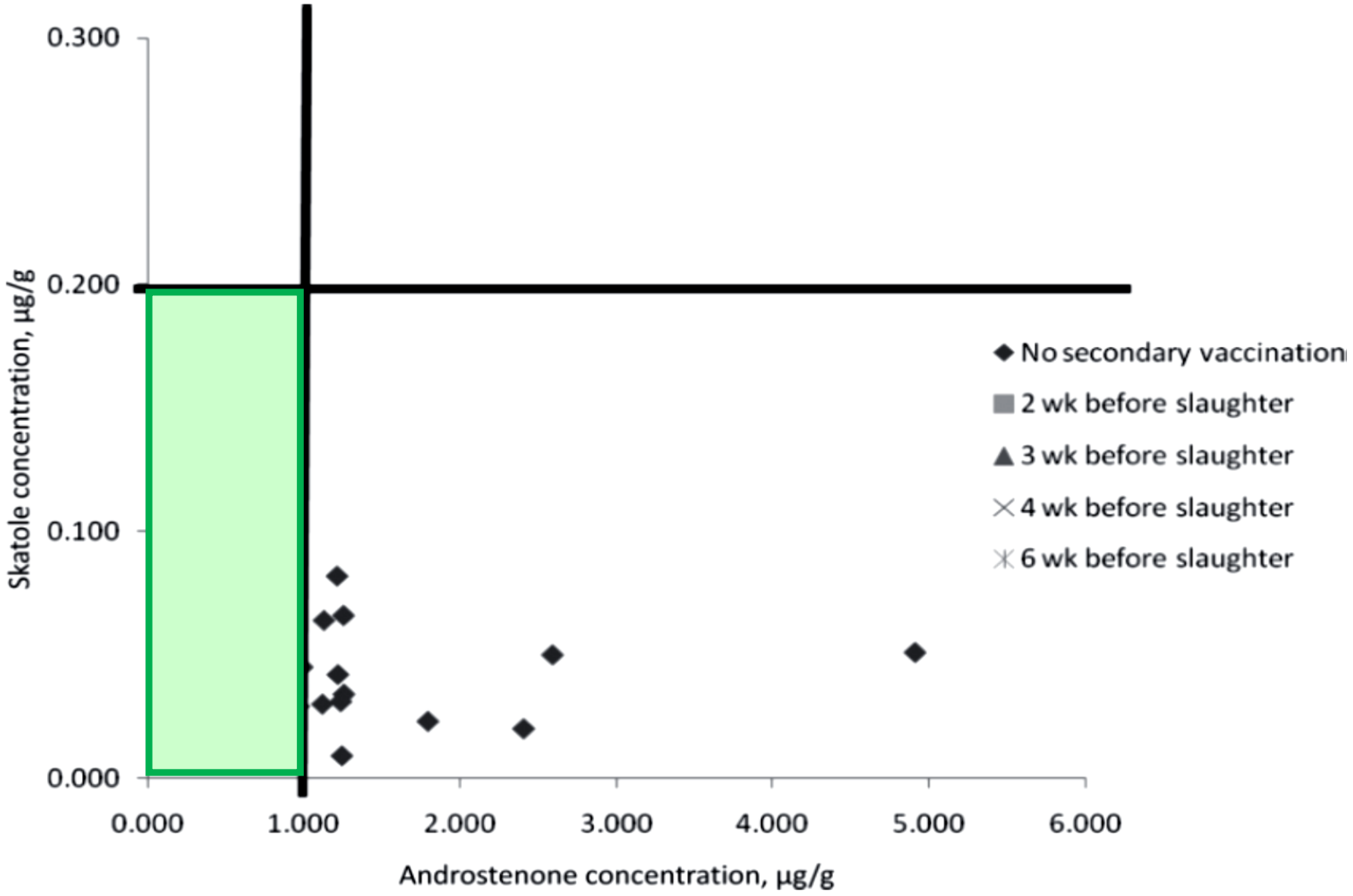
Batorek *et al.*, 2012

Table 3 *Lean meat percentage in BO, BA and IC, with corresponding average lean meat growth*

Reference	Lean meat percentage			Initial and final weight (kg)	Number of days	Carcass lean gain (g/day)[a]		
	BO	BA	IC			BO	BA	IC
Bonneau *et al.* (1994)	57.7	54.9	56.8	29 to 105	82	384	368	372
Dunshea *et al.* (2001)[b]	51.7	50.5	51.5	53 to 98	56	314	306	322
Dunshea *et al.* (2001)[b]	52.3	50.4	51.4	53 to 115	77	342	331	360
Zeng *et al.* (2002)	56.9	53.9	51.8	25 to 110	93	397	381	367
Zeng *et al.* (2002)	56.8	54.1	54.5	25 to 110	93	368	373	380
Turkstra *et al.* (2002)	55.5	54.9	56.2	23 to 109	95	378	360	377
Oliver *et al.* (2003)	69.5	–	67.8	64 to 103	28	707	–	708
Zamaratskaia *et al.* (2008)	57.8	54.9	56.1	26 to 124	98	420	395	400
Pauly *et al.* (2009)	57.5	54.5	56.3	27 to 107	90	386	385	389
Gispert *et al.* (2010)	61.2	57.3	57.9	120				

(Millet et al., 2011)

Androstenone and skatole concentration in carcass backfat



(Lealiifano *et al.*, 2012)

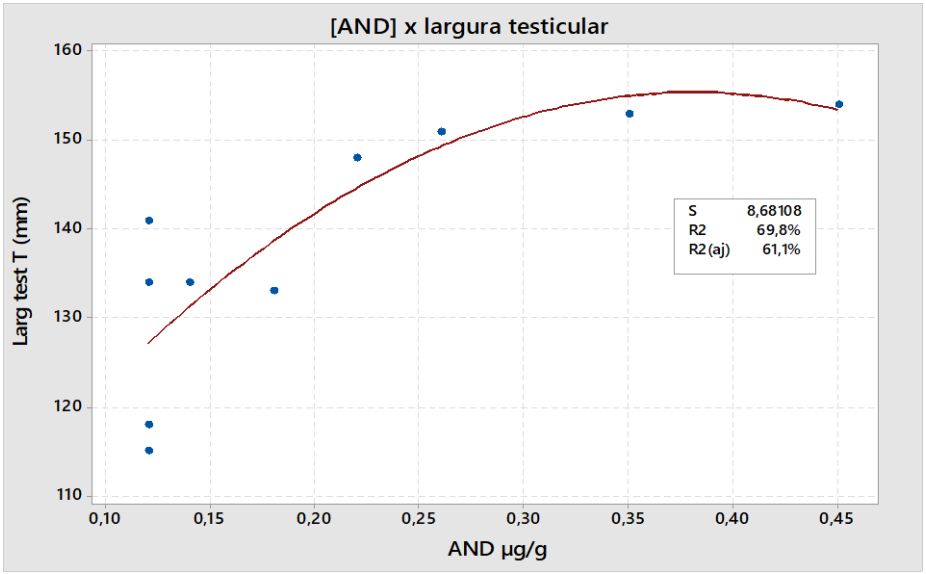
Control point inside the plant . 1 . Testis width

Control point at the plant . 2 . Hot water bath

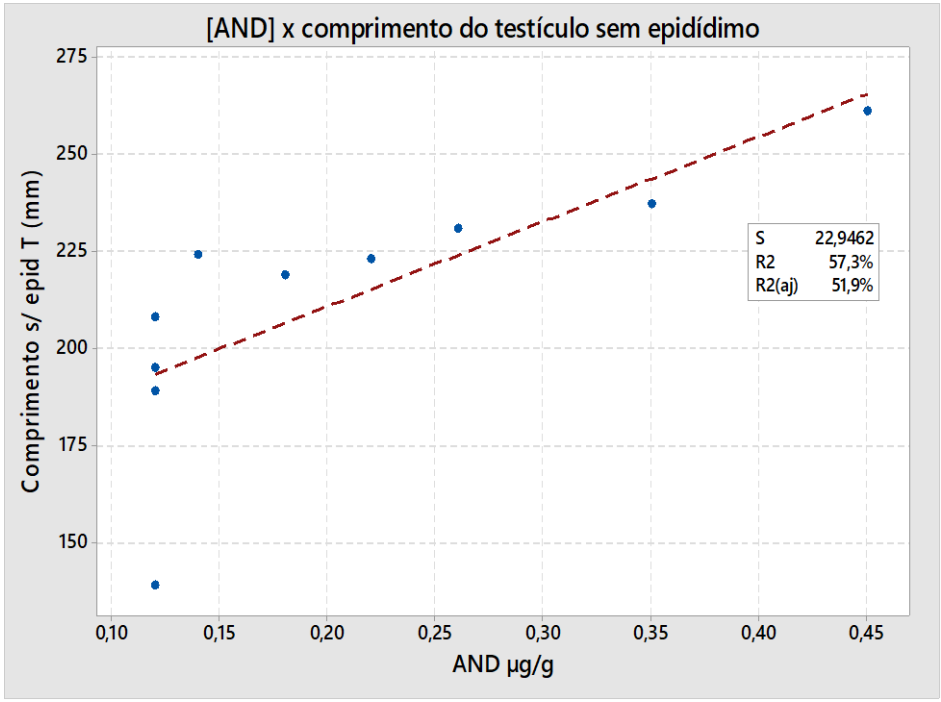
- SIF (Federal meat Inspection Service)
- Water bath - 12 Beckers with fat samples
- closed
- 45 - 55° C
- 2 to 5 minutes
- Smell: tainted or not
- Negative: carcass ok
- Positive: test again in 48 h
  or carcass downgrading

Pigs vaccinated against GnRH

AND (µg/g) fat x testis width (mm)

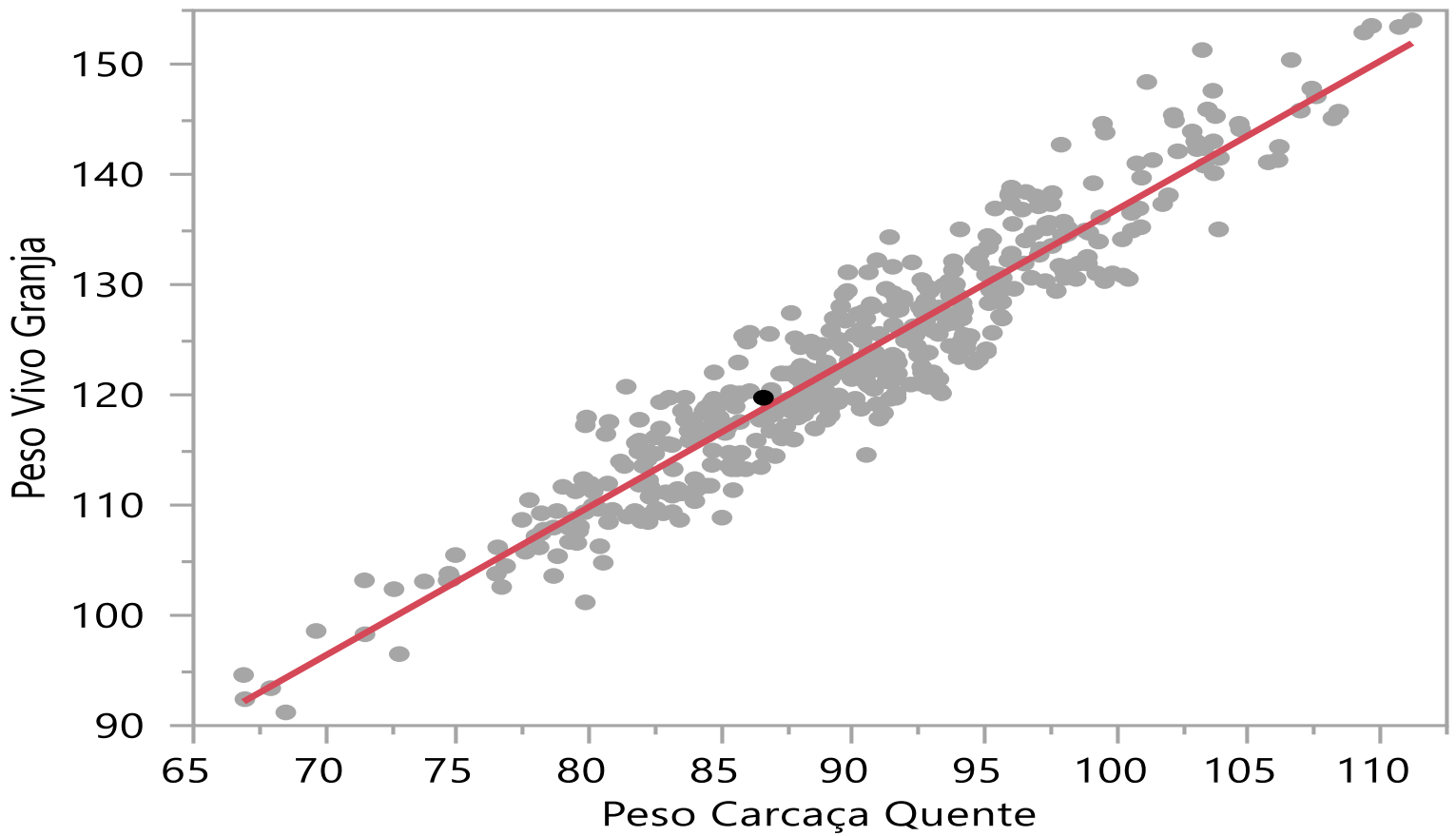


AND (µg/g) fat x testis length (mm)



TESTING IMC WITHIN A FULLY VERTICALISED PORK PRODUCTION SYSTEM

Live weight (kg) x hot carcass weight (kg) – dressing (n=453)



Live weight = 1,7407241 + 1,3518045*hot carcass weight

RSquare	0,895905
RSquare Adj	0,895674
Root Mean Square Error	3,588803
Mean of Response	123,3227
Observations (or Sum Wgts)	453

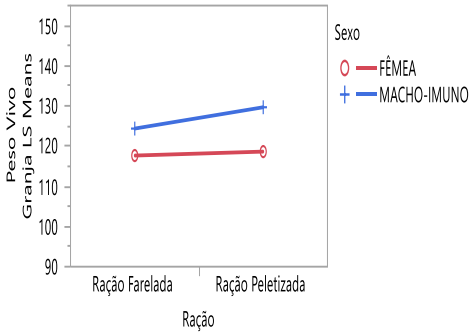
Live weight (kg)

Sexo*Ração

Least Squares Means Table

Level	Least Sq Mean	Std Error
FÊMEA,Ração Farelada	117,66383	1,4343454
FÊMEA,Ração Peletizada	118,64891	0,7249261
MACHO-IMUNO,Ração Farelada	124,37963	1,3381531
MACHO-IMUNO,Ração Peletizada	129,68512	0,7586615

LS Means Plot



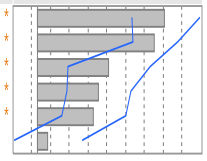
LSMeans Differences Student's t

α=0,050 t=1,96526

Level		Least Sq Mean
MACHO-IMUNO,Ração Peletizada	A	129,68512
MACHO-IMUNO,Ração Farelada	B	124,37963
FÊMEA,Ração Peletizada	C	118,64891
FÊMEA,Ração Farelada	C	117,66383

Levels not connected by same letter are significantly different.

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
MACHO-IMUNO,Ração Peletizada	FÊMEA,Ração Farelada	12,02129	1,622626	8,83241	15,21017	<,0001 *
MACHO-IMUNO,Ração Peletizada	FÊMEA,Ração Peletizada	11,03621	1,049326	8,97401	13,09841	<,0001 *
MACHO-IMUNO,Ração Farelada	FÊMEA,Ração Farelada	6,71580	1,961632	2,86068	10,57092	0,0007 *
MACHO-IMUNO,Ração Farelada	FÊMEA,Ração Peletizada	5,73072	1,521897	2,73979	8,72164	0,0002 *
MACHO-IMUNO,Ração Peletizada	MACHO-IMUNO,Ração Farelada	5,30549	1,538253	2,28242	8,32856	0,0006 *
FÊMEA,Ração Peletizada	FÊMEA,Ração Farelada	0,98508	1,607129	-2,17335	4,14351	0,5402



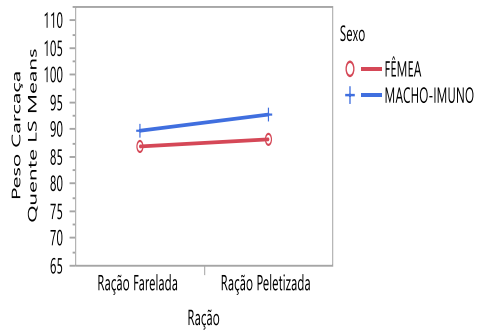
Hot carcass weight (kg)

Sexo*Ração

Least Squares Means Table

Level	Least Sq Mean	Std Error
FÊMEA,Ração Farelada	86,899149	1,0891958
FÊMEA,Ração Peletizada	88,197554	0,5504856
MACHO-IMUNO,Ração Farelada	89,782222	1,0161504
MACHO-IMUNO,Ração Peletizada	92,751250	0,5761031

LS Means Plot



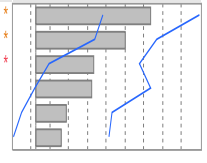
LSMeans Differences Student's t

α=0,050 t=1,96526

Level		Least Sq Mean
MACHO-IMUNO,Ração Peletizada	A	92,751250
MACHO-IMUNO,Ração Farelada	B	89,782222
FÊMEA,Ração Peletizada	B	88,197554
FÊMEA,Ração Farelada	B	86,899149

Levels not connected by same letter are significantly different.

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
MACHO-IMUNO,Ração Peletizada	FÊMEA,Ração Farelada	5,852101	1,232170	3,43057	8,273637	<,0001 *
MACHO-IMUNO,Ração Peletizada	FÊMEA,Ração Peletizada	4,553696	0,796824	2,98773	6,119664	<,0001 *
MACHO-IMUNO,Ração Peletizada	MACHO-IMUNO,Ração Farelada	2,969028	1,168100	0,67341	5,264649	0,0114 *
MACHO-IMUNO,Ração Farelada	FÊMEA,Ração Farelada	2,883073	1,489600	-0,04438	5,810527	0,0536
MACHO-IMUNO,Ração Farelada	FÊMEA,Ração Peletizada	1,584668	1,155680	-0,68655	3,855881	0,1710
FÊMEA,Ração Peletizada	FÊMEA,Ração Farelada	1,298405	1,220402	-1,10000	3,696815	0,2879



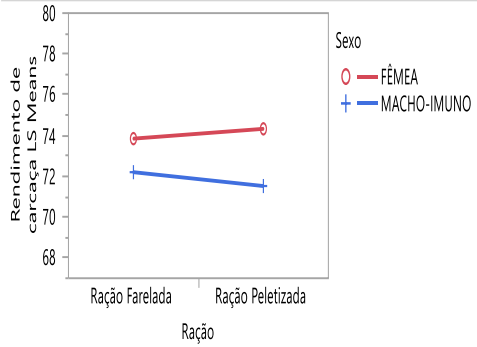
Hot carcass yield or dressing (%)

Sexo*Ração

Least Squares Means Table

Level	Least Sq Mean	Std Error
FÊMEA,Ração Farelada	73,845760	0,24403347
FÊMEA,Ração Peletizada	74,325867	0,12333587
MACHO-IMUNO,Ração Farelada	72,199810	0,22766772
MACHO-IMUNO,Ração Peletizada	71,521066	0,12907546

LS Means Plot



LSMeans Differences Student's t

α=0,050 t=1,96526

Level		Least Sq Mean
FÊMEA,Ração Peletizada	A	74,325867
FÊMEA,Ração Farelada	A	73,845760
MACHO-IMUNO,Ração Farelada	B	72,199810
MACHO-IMUNO,Ração Peletizada	C	71,521066

Levels not connected by same letter are significantly different.

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value	
FÊMEA,Ração Peletizada	MACHO-IMUNO,Ração Peletizada	2,804801	0,1785279	2,45395	3,155655	<,0001 *	
FÊMEA,Ração Farelada	MACHO-IMUNO,Ração Peletizada	2,324695	0,2760667	1,78215	2,867238	<,0001 *	
FÊMEA,Ração Peletizada	MACHO-IMUNO,Ração Farelada	2,126057	0,2589292	1,61719	2,634921	<,0001 *	
FÊMEA,Ração Farelada	MACHO-IMUNO,Ração Farelada	1,645951	0,3337438	0,99006	2,301845	<,0001 *	
MACHO-IMUNO,Ração Farelada	MACHO-IMUNO,Ração Peletizada	0,678744	0,2617118	0,16441	1,193076	0,0098 *	
FÊMEA,Ração Peletizada	FÊMEA,Ração Farelada	0,480106	0,2734302	-0,05726	1,017468	0,0798	

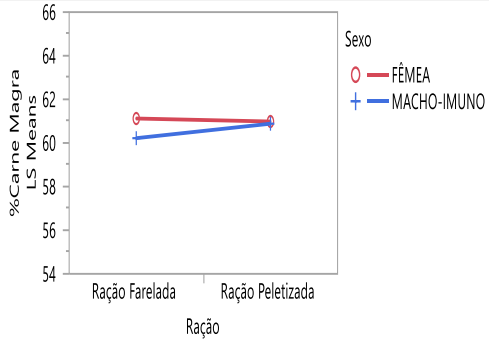
Lean (%)

Sexo*Ração

Least Squares Means Table

Level	Least Sq Mean	Std Error
FÊMEA,Ração Farelada	61,121702	0,27300945
FÊMEA,Ração Peletizada	60,984674	0,13798049
MACHO-IMUNO,Ração Farelada	60,219815	0,25470046
MACHO-IMUNO,Ração Peletizada	60,883869	0,14440159

LS Means Plot



LSMeans Differences Student's t

α=0,050 t=1,96526

Level		Least Sq Mean
FÊMEA,Ração Farelada	A	61,121702
FÊMEA,Ração Peletizada	A	60,984674
MACHO-IMUNO,Ração Peletizada	A	60,883869
MACHO-IMUNO,Ração Farelada	B	60,219815

Levels not connected by same letter are significantly different.

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value	
FÊMEA,Ração Farelada	MACHO-IMUNO,Ração Farelada	0,9018873	0,3733718	0,168114	1,635660	0,0161 *	
FÊMEA,Ração Peletizada	MACHO-IMUNO,Ração Farelada	0,7648591	0,2896738	0,195574	1,334144	0,0086 *	
MACHO-IMUNO,Ração Peletizada	MACHO-IMUNO,Ração Farelada	0,6640542	0,2927869	0,088652	1,239457	0,0238 *	
FÊMEA,Ração Farelada	MACHO-IMUNO,Ração Peletizada	0,2378331	0,3088462	-0,369130	0,844797	0,4417	
FÊMEA,Ração Farelada	FÊMEA,Ração Peletizada	0,1370282	0,3058967	-0,464139	0,738195	0,6544	
FÊMEA,Ração Peletizada	MACHO-IMUNO,Ração Peletizada	0,1008049	0,1997259	-0,291709	0,493318	0,6140	

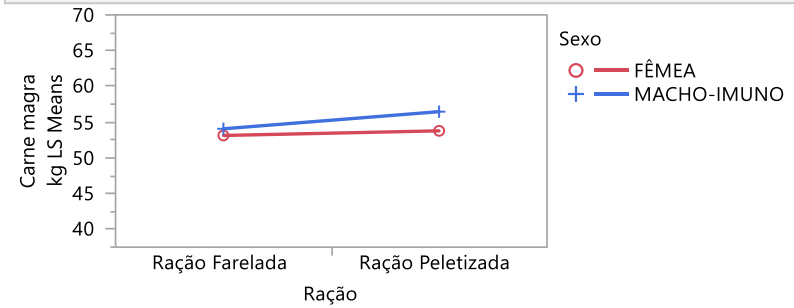
Lean (kg)

Sexo*Ração

Least Squares Means Table

Level	Least Sq Mean	Std Error
FÊMEA,Ração Farelada	53,131427	0,69263919
FÊMEA,Ração Peletizada	53,775538	0,35006370
MACHO-IMUNO,Ração Farelada	54,062504	0,64618833
MACHO-IMUNO,Ração Peletizada	56,459753	0,36635435

LS Means Plot



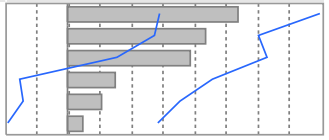
LSMeans Differences Student's t

α=0,050 t=1,96526

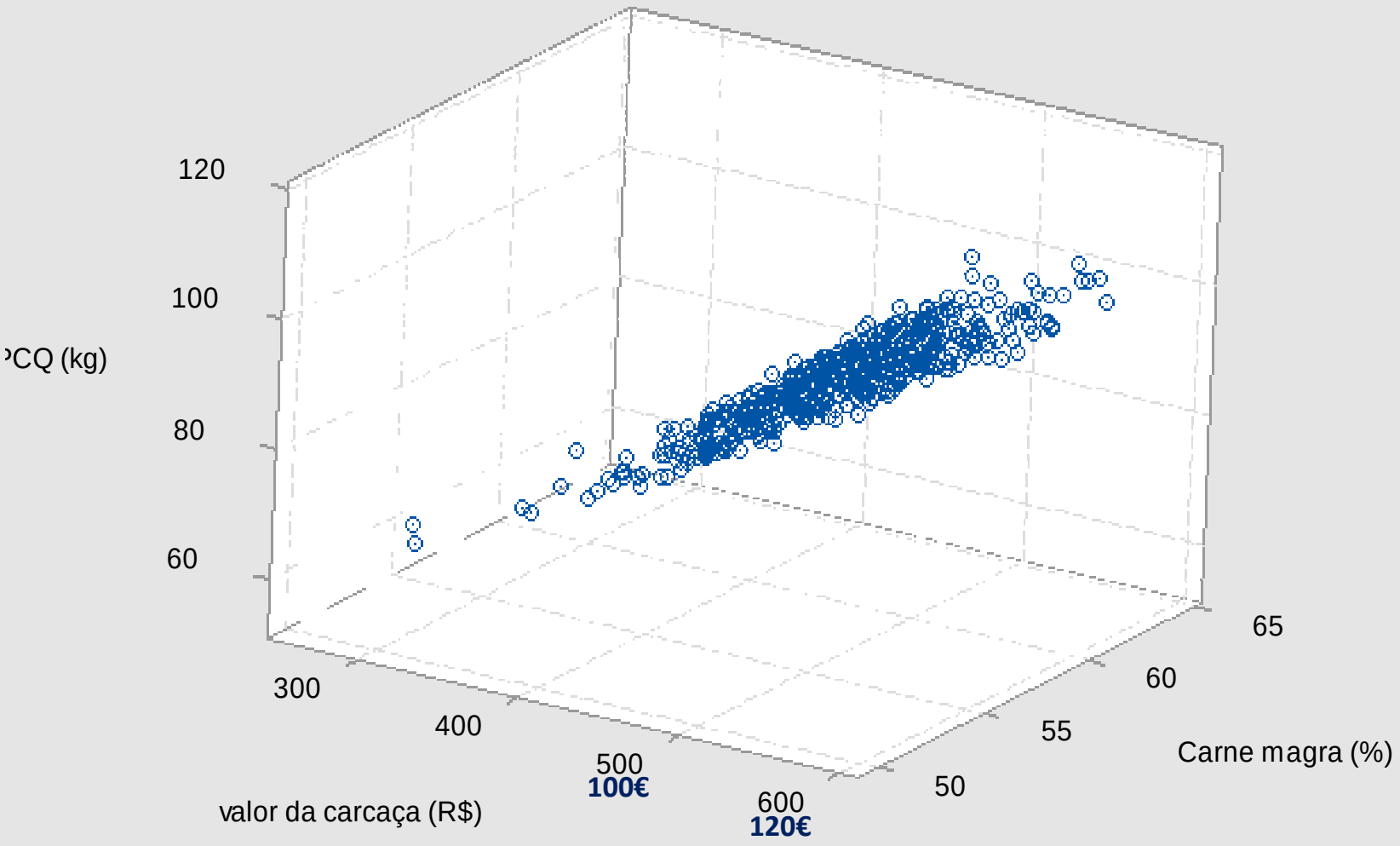
Level			Least Sq Mean
MACHO-IMUNO,Ração Peletizada	A		56,459753
MACHO-IMUNO,Ração Farelada		B	54,062504
FÊMEA,Ração Peletizada		B	53,775538
FÊMEA,Ração Farelada		B	53,131427

Levels not connected by same letter are significantly different.

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
MACHO-IMUNO,Ração Peletizada	FÊMEA,Ração Farelada	3,328326	0,7835589	1,78843	4,868224	<,0001 *
MACHO-IMUNO,Ração Peletizada	FÊMEA,Ração Peletizada	2,684216	0,5067150	1,68839	3,680043	<,0001 *
MACHO-IMUNO,Ração Peletizada	MACHO-IMUNO,Ração Farelada	2,397249	0,7428155	0,93742	3,857076	0,0013 *
MACHO-IMUNO,Ração Farelada	FÊMEA,Ração Farelada	0,931077	0,9472636	-0,93054	2,792698	0,3262
FÊMEA,Ração Peletizada	FÊMEA,Ração Farelada	0,644110	0,7760758	-0,88108	2,169302	0,4070
MACHO-IMUNO,Ração Farelada	FÊMEA,Ração Peletizada	0,286967	0,7349176	-1,15734	1,731272	0,6964



Relação peso, % carne magra e valor da carcaça



1€ = R$ 4.90

Final remarks

- Very few, if any, available studies on the “tolerance” for adrostenone with South Americans pork consumers.

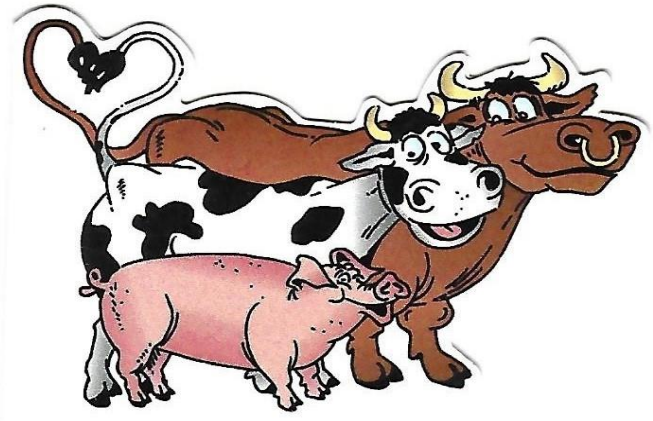
- Welfare and antibiotics usage are the current concerns of the pork chain in Brazil.

- IMC involves from nursery to carcasses. When compared to physical castration, it promotes significant changes in carcass lean to fat ratio.

- IMC keeps [AND] very low in fat, thus there is no fear of public rejection of pork products made from IMC pigs. However, IMC adds two more “shots” to a total of 10 to 13 shots pigs normally takes from birth to market.

- Can be cost effective in most production systems, but the return over investments tends to be higher in fully vertical operations.

- Welfare friendly. Initial costs are supposed to drop, basically due to new manufactures of IMC vaccines coming into Market.



Thanks **Merci**

Jose Vicente Peloso
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Danke **Gracias**

I support WAP