Pork and the superbug crisis

How higher welfare farming is better for pigs and people

WORLD ANIMAL PROTECTION

Contents

Cover: In the first week of their lives, piglets get their tails docked. With no anaesthesia, a pair of hot cauterised scissors cuts their tails. This practice does not prevent later tail biting where pigs redirect frustration at their barren environments onto one another. This piglet is being hung upside down whilst its tail is cut.

Moving the world for farm animals

During 2017 we gave 321 million animals better lives through our campaigns that focus on animals in farming; animals in disasters, animals in communities and animals in the wild.

Our Raise Pigs Right campaign, launched in April 2018, is moving consumers, the food industry, governments and supermarkets to help transform the lives of pigs suffering in intensive factory farms around the world.

Together we have the power to end their suffering. Getting pigs out of cages into social groups, giving them materials like straw to manipulate, and stopping painful mutilations. So, pigs can be pigs - live pain-free, move, play, forage, explore, socialise and experience natural behaviour.

Image: Pregnant mother pigs live in cramped cages (gestation crates) where they can barely move. This causes severe stress, discomfort and suffering, but these are still used in many parts of the world. (These photos are from an undisclosed location in Latin America).

Foreword

Pigs around the world are suffering in factory farms fuelled by consumer demand for cheap pork. But, pigs are not cogs in a machine. They are living, breathing animals; they feel pain, stress and pleasure.

Within the harsh confines of factory farming, these highly intelligent animals are subjected to painful mutilations and confined to cramped, barren cages. It is impossible for them to fulfil their hardwired instincts to forage, to build nests and give birth in comfort.

The intense physical and mental stress the world's factory farmed pigs suffer should naturally hinder their growth, development and make them unwell. But, for years antibiotics administered on an industrial scale has stopped stressed animals getting sick and propped up unacceptable farming methods.

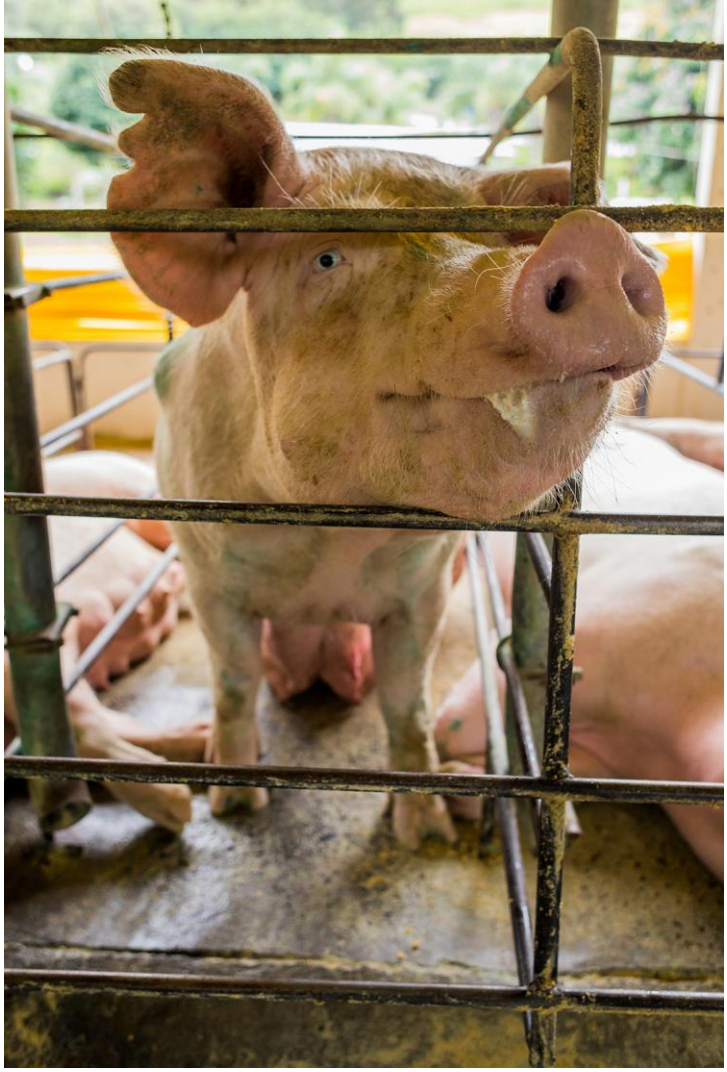
This is a risky business. Superbugs are emerging on farms from antibiotic overuse, and those superbugs are entering our food chain and our environment. When antibiotic resistant superbugs are passed to people, they make us less able to fight disease.

This World Animal Protection report is a powerful step forward in raising awareness on the link between low welfare on factory farms, and its impact on both pigs and people. It highlights how the overuse of antibiotics can affect our food and our health. It shows how by creating better welfare conditions, pig producers can reduce antibiotic use and help to tackle the global superbug crisis.

Producers and supermarkets are already joining forces to give pigs better lives. Inspired by our Raise Pigs Right campaign, the largest supermarket chain in the US, Kroger, has committed to ending the confinement of pregnant pigs by 2025[1]. And in Thailand, CP Foods has committed to ending confinement of pregnant pigs in Thailand by 2025 and globally by 2028[2].

We're uniting to do better for pigs - it's time to Raise Pigs Right.

Jacqueline Mills
Global Head of Farming



Left: **Pregnant mother pig in a cage.**

Executive summary

Factory farming is heavily dependent on antibiotics[3] to keep pigs healthy and productive in distressingly cruel, caged and unnatural conditions, fuelling the global superbug crisis.

Many of the same antibiotics used in farming are also used to treat people when they are sick and are considered as critically important to human health by the World Health Organization (WHO).

With superbug bacteria developing resistance to one or more classes of antibiotics; antibiotics widely used in pig farming have become less effective or completely ineffective in treating infections in people.

Superbugs, also known as antimicrobial resistant bacteria (AMR) already kill 700,000 people across the world each year. This is projected to rise to 10 million deaths annually by 2050[4].

The United Nations is also concerned about environmental contamination, with antibiotic residue and superbugs found in water in areas surrounding factory farms across the world[5].

The world's supermarkets are exacerbating the problem by buying from suppliers who rear their pigs in low welfare conditions.

Simply ending the use of antibiotics on factory farms is not the answer. Higher animal welfare is the answer and must always be front and centre.

Global snapshot – worldwide problem

This report focuses on retail pork product testing conducted for World Animal Protection in four countries during 2018. The testing was commissioned to identify bacteria present in pork meat, and to test for strains resistant to specific antibiotics.

Although previous studies have found superbugs in retail poultry and pork products in different countries[6], this report is the first global snapshot of the presence of superbugs in retail pork products. It exposes a global problem.

Pork samples from major supermarket chains, in Australia, Brazil, Spain and Thailand, were tested. Alarmingly, superbugs resistant to antibiotics, considered most critically important to human health by the World Health Organisation (WHO), were found within the samples sold by major supermarkets in three of the four countries (Brazil, Spain and Thailand) including in samples from Carrefour in Spain and Walmart in Brazil[7].

Evidence associates low welfare pig farming with routine antibiotic overuse. While, improved farm animal welfare allows for a responsible reduction in antibiotic use and a safe supply of meat to consumers.

For example, Sweden's 1986 ban of antibiotic use to promote growth in pig farming, and the adoption of higher welfare farming methods, resulted in a 65% drop in antibiotic use up to 2015[8].

Recent research by World Animal Protection found that consumers are keen for change. Four out of five supermarket customers, surveyed in Australia, Brazil and Thailand[9], said they worry about the effects on their health of routine antibiotic use in farming. They also found the ways pigs are treated in factory farms a big concern. Most said they found standard images of conditions for pigs on factory farms "upsetting", "wrong" or "shocking".

It is essential supermarkets, the main buyers of pork, address with their suppliers the issue of low animal welfare as part of the move towards responsible antibiotic use to tackle the superbug crisis.

By getting pigs out of cages and into groups with room to move, and materials like straw to manipulate, animals are less stressed. By giving piglets longer with their mothers before weaning, and by ending painful mutilations like surgical castration, tail cutting and teeth clipping, animals become more robust, needing less antibiotics.

Higher welfare farming methods already practiced by responsible suppliers worldwide must be rolled out globally. This report shows how such action will reduce the need for routine overuse of antibiotics and protect people's health from the superbug crisis.

Left: A group of pigs. There is no ear notching, which is good, however all pigs are tail docked.

Left: An injured pig after a fight with other pigs. Fighting is exacerbated by stress from barren environments

Farming and excessive antibiotic use

Currently, 131,000 tonnes of antibiotics are used annually in farming to promote growth, and to prevent and treat disease[10]. About three quarters of all the antibiotics used in the world are thought to be used on farm animals[11].

Major health concerns for people centre on the use of antibiotics considered by the World Health Organisation (WHO) to be of highest priority and critically important to human health. These antibiotics include antibiotics used in pig farming: colistin, fluoroquinolones, third generation cephalosporins, and enrofloxacin[12].

Highest priority critically important antibiotics are classes of antibiotics where there are few or no alternatives to treat people with serious infections. The UN's Food and Agriculture Organization (FAO) recommends that these classes of antibiotics should not be used in animal agriculture[13]. This is to help preserve their effectiveness in treating infections in people.

However, these classes of antibiotics remain widely used in factory farming. This is despite substantial evidence that routine overuse of antibiotics on farms creates the conditions for superbugs to emerge, and leads to the finding of superbugs in animals, on farms and in the food chain.

The pig industry also uses more antibiotics than other farming sectors[14] to promote growth and tackle issues in low welfare practices. Antibiotics commonly used in piglets, subjected to tail docking or surgical castration, include ampicillins and tetracyclines.

Antibiotics are often used for piglets, following early weaning from their mothers to prevent illness. They are also used in the feed of pigs raised for meat during acute stress caused to the animals by overcrowding and changes in group composition.

Antibiotics used may include colistin, ampicillin, fluoroquinolones, third generation cephalosporins, enrofloxacin, gentamicin, tylosin, tetracyclines, sulfadiazines, and phenicols, among others.

Mother pigs (sows) are also routinely administered antibiotics to prevent them succumbing to urinary, hoof, vaginal and shoulder infections, due to stress and injury caused by close confinement or poor living conditions.

Building resistance – the rise of the superbug

Superbugs are bacteria that have developed resistance to one or more classes of antibiotics, rendering those antibiotics less effective in treating infections. Superbugs are also known as antimicrobial resistant bacteria (AMR). They represent a significant threat to human health, killing 700,000 people worldwide annually. This is projected to rise to 10 million deaths annually by 2050[15].

There are more than 100 scientific papers regarding superbugs found on farms, referencing extensive sampling and testing across Europe, the USA, China, Thailand, Brazil, Australia and elsewhere. This research shows the longer and more extensively antibiotics are used (particularly in feed or water) on farms, the higher the rates of resistant bacteria in farm animals.

A European Union co-financed project tested dung of pigs and broiler chickens across nine countries. It concluded that levels of antimicrobial resistance in the gut of these animals was directly linked to the type and level of antibiotic usage on farms[16]. Where antibiotics of critical importance to human health like colistin have been mass administered, as in China, new resistance genes continue to emerge on farms[17].

There is documented evidence that superbugs can enter the food chain passing from farm animals, to slaughter houses and onto the meat we eat. Once consumed, antibiotics are also excreted from farm animals, and can be released directly into the environment contributing further to the superbug crisis.

Widespread use – a global snapshot

- The five countries with the largest antibiotic consumption by food animals produced in 2010 were: China (23%); USA (13%); Brazil (9%); India (3%) and Germany (3%)[18].
- In China, approximately 48,400 tonnes of antibiotics were sold for use in pig production in 2013[19].
- In the US, nearly 8,400 tonnes of antibiotics were sold for use in pig production in 2016[20].
- The use of antibiotics to promote growth has been officially banned in the European Union, but the volume of antibiotics used in farming remains substantial in many countries, primarily for disease prevention[21].

2030 projections for antibiotic use in farming[22]

- Antibiotic consumption is projected to rise by 67% from 2010 levels.
- The greatest percentage increases in antibiotic use are projected for: Myanmar (205%); Indonesia (202%); Nigeria (163%); Peru (160%), and Vietnam (157%); as these countries adopt more intensive farming systems.
- Antibiotic consumption in Brazil, Russia, India, China and South Africa is predicted to increase by 99% from 2010 levels. The rising use in these middle-income countries is likely to be driven by the growth in consumer demand for livestock products, and a shift to large-scale farms

Regulations on use of antibiotics in agriculture vary significantly by country. See Appendix 1.

Overall, the monitoring of antibiotic use on farms is in its infancy. The FAO is concerned that only 89 countries are currently measuring use of antibiotics in farm animals[23].

Testing supermarket pork – superbugs exposed

Retail pork product testing

Our retail product testing in 2018 focused on identifying the presence of bacteria in supermarket pork, and whether bacteria strains were resistant to specific antibiotics.

The project was prompted by current research suggesting a link between low welfare farming and antibiotic overuse, and an exploration of literature regarding the pig industry's contribution to superbugs and transmission possibilities to the food chain.

Methodology

Across four markets (Australia, Brazil, Spain and Thailand) fresh, packaged pork was purchased from a range of supermarkets. It was delivered on ice to independent accredited laboratories for testing.

A mixture of pork mince and fresh pork cuts, of average price, were chosen for testing.

All samples were already sealed by the supermarket, within expiry dates, and maintained at refrigerated temperature.

Product labelling was covered over so that the origin of samples remained unknown to the laboratories.

Laboratories included:

1. Melbourne University, Australia
2. Ipromoa, an EU-accredited private laboratory, Spain
3. University of Sao Paulo, Brazil
4. Chulalongkhon University, Thailand

Laboratories conducted a two-step process. This involved testing samples for presence of key food-borne bacteria. Where such bacteria were found, they were tested for resistance or susceptibility to specific antibiotics.

Further detail on methodology appears in Appendix 2.

Key findings

Testing results indicated widespread presence of bacteria across samples from all supermarkets. They also showed that these bacteria were resistant to a range of antibiotics commonly used in pig farming.

Resistance to antibiotics of 'highest priority critical importance to human health', as defined by WHO, was found in three of the four countries from where samples were taken. This included samples from Carrefour in Spain and Walmart in Brazil. Comprehensive results appear below.

Country

Spain

- Extensive bacterial contamination (E coli found in 155/200 samples: 77.5%). Bacterial resistance was found across these 155 E coli positive samples. This included resistance of E coli to antibiotics of 'highest critical importance to human health' from Carrefour: ofloxacin (29% of E coli found was resistant to ofloxacin), ciprofloxacin (18.7% of E coli found was resistant), colistin (3.2% of E coli found was resistant).
- Multi Drug Resistant (MDR) bacteria were prevalent (64.5 % of all E coli found were MDR). MDR means resistance to 3 or more different classes of antibiotics.

Thailand

- Bacterial contamination (Of 150 samples, E coli was found in 97% of samples; and Salmonella was found in 50% of samples. Bacterial resistance was identified across samples from two supermarkets (Tesco Lotus and Tops Market).
- 97% of all E coli and 93% of all Salmonella were MDR.
- ESBL positive E coli were prevalent (10% of all E coli found). Such E coli are inherently resistant to antibiotics cephalosporin and ampicillin. Third-generation and later cephalosporin antibiotics are of 'highest critical importance' to human health.
- Bacterial resistance to antibiotics of 'highest and high critical importance to human health' was found. Across E coli found in Tesco Lotus samples, resistance was found to; cefotaxium (15% of samples containing E coli), cefpodoxium (15%) and across E Coli and Salmonella found in Tesco Lotus samples, resistance was found to gentamicin (19%), streptomycin (96.8%), ampicillin (100%).
- Bacterial resistance to antibiotics 'highly important' to human health was also found: Across E coli and Salmonella found in Tesco Lotus samples; resistance was found to tetracycline (96.7% of samples containing E coli or Salmonella) and chloramphenicol (61%).

Brazil

- High levels of E coli bacterial contamination (92% across all 100 samples) and MDR (33.6% across all samples) from the four supermarkets sampled: Carrefour, Walmart, Extra (Casino Group) and Pao de Acucar (Casino Group).
- Bacterial resistance to fluoroquinolones was found in samples from three of the four supermarkets. Fluoroquinolones are antibiotics of 'highest critical importance' to human health.
- Bacterial resistance to amikacin (resistant E coli) and to sulphonamides (antibiotic resistant Salmonella) was found in samples from Extra (Casino Group) and Pao de Acucar (Casino Group). Amikacin is an antibiotic of 'high critical importance to human health'. Sulphonamides are antibiotics 'highly important to human health'.
- One Carrefour sample contained E coli ESBL positive bacteria. Such E coli have inherent cephalosporin and ampicillin resistance. Third-generation and later cephalosporin antibiotics are 'highest critical importance' to human health.
- Walmart samples were also found to have E coli resistant to ceftiofur and colistin. These are antibiotics of 'high importance and highest critical importance' to human health. Colistin was banned for use in farm animals in Brazil in 2016.

Country	
Australia 	• Bacterial contamination was found. Of 300 samples across 3 supermarkets (Coles, Woolworths, Aldi), E coli was found ranging from 36% to 70% of samples from each supermarket and Enterococcus was found ranging from 36% to 90% of samples from each supermarket. • Moderate to high levels of resistance were found to ampicillin/tetracycline in E coli and to tetracycline/streptogramins in enterococcus. • MDR was found in Woolworths (E coli) and Coles (enterococcus) samples only. • No resistance to drugs of 'highest critical importance to human health' was found.

Implications for consumers

Routine antibiotic overuse is closely associated with low welfare practices, including early weaning, painful mutilations and caging of mother pigs.

The limited product sampling for this report aligns with wider research pointing to the need for responsible reduction in antibiotic use in the pig industry. Our interest is in pointing to the evidence that higher welfare practices can allow responsible antibiotic use.

We cannot comment on the specific health implications for consumers relating to the products sampled. However, the European Medicines Agency confirms that resistant bacteria can be transmitted to people via the food chain and be carried in the human intestines. This can carry a risk of infection for the young, the elderly, or those with compromised immunity[24].

Illnesses can include food poisoning, diarrhoea, urinary tract infections and kidney failure.

Superbug contributor

The routine overuse of antibiotics in animal agriculture is recognised by WHO and the UN as a significant contributor to the emergence of superbugs, causing drug-resistant food poisoning, blood poisoning and urinary tract infections that can be fatal[25].

Bacteria in meat (like E coli and Salmonella) can survive the cooking process; although health authorities generally recommend cooking meat at high temperatures to minimise risk. However, this does not negate the risk on farms or in slaughterhouses to workers who may be exposed to superbugs during their work, or to their families and the environment.

In 2011, the USA's Center for Disease Control recalled a large volume of turkey mince after resistant Salmonella in the meat was linked to 136 illnesses and one death[26].

Sharing results with supermarkets

There is an opportunity for supermarkets to support the pig industry to responsibly reduce antibiotics, while improving animal welfare.

We shared the retail pork product testing results with supermarkets prior to release of this report, to encourage them to source their pork from suppliers with higher animal welfare policies.

We are engaging in constructive dialogue with supermarkets including Carrefour in Brazil, Casino Group in Brazil, and Tesco Lotus in Thailand.

We note that Tesco Lotus and Tops Market are parties to a Memorandum of Understanding with industry and government in Thailand to reduce antibiotic use in farming.

Earlier in 2018, we welcomed a commitment from Tops Market to phase out cages for pregnant pigs in their supply and to fully implement group housing for pregnant pigs with manipulable materials to allow for expression of natural behaviour by 2027.

We do not believe the superbug presence in specific pork samples proves the presence of superbugs on specific suppliers' farms. This is because of contamination possibilities across the supply chain.

This means that supermarkets should not respond to these findings by acting against any specific supplier. Rather, they should call on all suppliers to address antibiotic overuse by improving pig welfare practice.

Across the board, because the testing results indicate widespread presence of superbugs, there is clearly a pervasive problem across many, many farms in different markets.

Left: Mother pig in group housing with straw to explore and forage in. Straw also provides additional fibre in her diet.

Reducing use – Sweden's success

Sweden is at the forefront of reducing antibiotics in farming to counteract superbugs. The country has proven it's possible to maintain or increase productivity without routine antibiotic use, through improving environmental and animal welfare management.

In 1986, Sweden became the first country to ban the use of antibiotics to promote growth. In the same year, a requirement for veterinary prescriptions for use for disease prevention or treatment, was also introduced.

Antibiotic use for managing disease initially spiked in the four years following the ban on using antibiotics to promote growth. However, an overall 50% drop in antibiotic use was realised by 1993.[27] By 2015 there was a 65% decrease in antibiotic use in pigs, compared with pre-ban levels.[28]

Reducing mortality and improving growth

Over the ten years following the ban on antibiotics to promote growth, fewer piglets died and growth rates improved[29].

To mitigate any negative impacts of banning routine antibiotics, farming practices were adapted to minimise the spread of disease. This involved moving to batch production, sometimes called 'all-in, all-out'. This means pigs are moved from one pen to another in batches to allow thorough cleaning of animals and their housing, and to minimise contact between younger and older animals.[30]

Welfare improvements allowing for reduced antibiotic use, include extending the time piglets spend with their mothers before weaning, and reduced stocking densities. In Sweden, piglets are weaned at a legal minimum of four weeks.[31] This compares with most EU countries, where piglets can be weaned as early as 21 days[32].

A study comparing weaning practices and antibiotic use in Sweden, Belgium, France and Germany, found median antibiotic use in weaner piglets was over 100 times lower in Sweden, than in the other three countries[33].

On the Swedish farms, the median weaning age was 35 days, whereas in the other three countries it was between 22 and 25 days.

In Sweden, pigs are not allowed to be confined in cages and it is not permitted to cut their tails. And, instead of living on bare concrete, pigs must be provided with bedding, such as straw.

There is also an economic incentive to move to higher welfare, with the government paying a subsidy to pig producers with welfare practices above the legal minimum.[34]

Above: Mother pig in group housing with straw to explore and forage in. Straw also provides additional fibre in her diet.

Moving forward to raise pigs right

Conclusion

Pork is big business, with supermarkets spending millions each year to source pork from producers around the world. This gives them significant influence over the way pigs are raised. They have a responsibility to use that influence to improve production practices, to benefit pigs and people.

Our retail pork testing results show the widespread presence of superbugs. The findings complement strong existing research on how excessive antibiotic use on farms is creating the conditions for emergence of superbugs, and the opportunities for transmission to the food chain.

Consumers are highly concerned for both their own health and the welfare of pigs.

World Animal Protection's Raise Pigs Right campaign is calling for pigs to be freed from cages, not to suffer in barren environments and be spared painful mutilations. Instead, these highly intelligent animals should be allowed to live in groups, with room to move, and be given opportunities to express their instinctive natural behaviours.

Our work with leading global pig producers shows that change is possible and higher welfare systems are good for animals, good for people, and good for business too.

Our recommendations

The evidence is clear that raising pigs right is the only way to address the industry's contribution to the superbug crisis - and the time to change is now. We are calling for the following urgent actions.

Supermarkets must...

- **Strengthen** their pork procurement policies to stop pigs being kept in cages, barren environments and subjected to cruel and painful mutilations. Supermarkets should only use suppliers who keep pigs in groups, on comfortable flooring and allow the animals opportunities to express natural behaviour.
- **Publish** annual reports on their progress towards implementing higher pig welfare commitments.
- **Require** suppliers to commit to using antibiotics responsibly in pig farming: ending the use of antibiotics to promote growth and to prevent disease across herds. They should not, however, pursue 'no antibiotics ever' or 'raised without antibiotics' policies or product lines; this can create a disincentive for producers to treat sick animals and does not address underlying welfare issues.

Pig producers must...

- **Plan** to stop using cages, barren environments and performing painful mutilations. Their plans should show how they will keep pigs in groups, with comfortable flooring and give them opportunities to express natural behaviour.
- **Use** systems that allow for better welfare, as outlined in World Animal Protection's global pig welfare framework, and publicly commit to doing so.
- **Commit** to using antibiotics responsibly in pig farming. This means not using antibiotics to promote growth or to prevent disease across herds. They must not adopt 'no antibiotics ever' or 'raised without antibiotics' policies. Antibiotics should be available to treat sick animals.

Governments must...

- **Strengthen** policy and regulatory frameworks to support the development of pig farming systems, allowing for better animal welfare and responsible antibiotic use reduction. This includes ensuring subsidies support higher welfare practices.

Consumers should...

- **Choose** higher welfare options where available. If high welfare products are not available, consumers should press retailers to sell them.
- **Not** equate 'no antibiotics ever' or 'raised without antibiotics' labelling with higher animal welfare. Antibiotic use for promoting growth and to prevent disease across herds must end, however antibiotics are needed to treat sick animals. Higher welfare systems allow for responsible reduction of antibiotics.
- **Urge** supermarkets to commit to improve pig welfare by joining our Raise Pigs Right campaign: **www.worldanimalprotection.org/raise-pigs-right**

Above: **Mother pig in group housing with straw to explore and forage in. Straw also provides additional fibre in her diet.**

Appendix 1

Country	Regulatory context for antibiotic use in farming
Australia	Use of antibiotics regulated at state level. Some antibiotics to promote growth permitted, plan to remove growth promotion use on antibiotic labels for antibiotic classes important to human health. Certain antibiotics may not be used in farm animals (gentamicin, fluoroquinolones, colistin, cefquinome, fourth generation cephalosporins) and third generation cephalosporins are restricted[35],[36].
Brazil	Follows Codex Alimentarius recommendations on antibiotics: no mandatory registration of antibiotic use. Antibiotics commonly used to promote growth. Some regulations apply to broiler production for export but do not apply to pig production[37]. Colistin banned in pig farming in 2016[38].
Canada	As of 1 December 2018, use of antibiotics important to human health requires veterinarian oversight, and no antibiotics important to human health may be used for promoting growth. Use of antibiotics for mass disease prevention permitted[39].
China	No requirement for veterinary oversight of antibiotic use. National plan to reduce the use of antibiotics important to human health by 2020[40]. Pilot farms to reduce use of antibiotics for promoting growth from 2018-2021[41].
Denmark	Antibiotic use for promoting growth banned in 2000. Veterinary oversight for all antibiotics required. Restrictions on certain classes of antibiotics including fluoroquinolones and voluntary industry ban on cephalosporins. Government surveillance and limits on antibiotic use volumes via Yellow Card scheme[42].
European Union[43]	Antibiotic use for promoting growth banned by the EU in 2006[44]. Veterinary prescription requirement for antibiotics[45]. Antibiotic use for mass disease prevention permitted. Legislation passed in October 2018 (not yet enacted) to limit the use of antibiotics for mass disease prevention, and to empower the European Commission to place restrictions on antibiotics important to human health. The legislation also mentions that food imported into the European Union must not come from food animals where antibiotics have been used to promote growth[46].
Kenya	Use of chloramphenicol and nitrofurans in farming, including for promotion of growth, prohibited in 2010[47].

Country	Regulatory context for antibiotic use in farming
Mexico	Use of antibiotics to promote growth in animal feed restricted, however some exemptions apply. Veterinary prescription for antibiotics required[48].
Netherlands	Use of antibiotics not permitted for mass disease prevention. Some restrictions on certain classes of antibiotics of critical importance to human health[49].
New Zealand	Antibiotics listed as critically and highly important to human health by World Health Organisation must not be used for promoting growth. Certain antibiotics require veterinary prescription[50].
Spain	As part of the EU, use of antibiotics for promoting growth banned, however routine mass preventative use of antibiotics is permitted[51].
Taiwan (China)	Antibiotics for promoting growth banned in 2005 and veterinary prescription for antibiotics required[52].
Thailand	Use of antibiotics for promoting growth prohibited, new antibiotics for human use may not be used in animals, certain antibiotics must be prescribed by veterinarians, controls on use of antibiotics in animal feed[53].
Sweden	Ban on use of antibiotics for promoting growth and requirement for veterinary prescriptions for antibiotics since 1986. Ban on use of antibiotics for mass disease prevention since 1988[54].
UK	Requirements to report on antibiotic use. The Veterinary Medicines Directorate recommends that antibiotics critically important to human health are only used in farm animals following illness being diagnosed[55]. Many antibiotics are still permitted for use for mass disease prevention.
USA	As of January 2017, use of antibiotics important to human health in feed and water requires veterinarian oversight, and no antibiotics important to human health may be used for promoting growth. Use of antibiotics for mass disease prevention permitted. Antibiotics not considered important to human health may be used for all purposes, including promoting growth and improving feed efficiency[56].

Appendix 2

Pork testing methodology

Samples were collected as follows:

Sao Paulo, Brazil:

- Carrefour - 5 supermarket outlets - 25 samples
- Walmart - 5 supermarket outlets - 25 samples
- Pão de Açucar (Casino Group) - 5 supermarket outlets - 25 samples
- Extra (Casino Group) - 5 supermarket outlets - 25 samples

Bangkok, Thailand:

- Tesco-Lotus100 samples (divided into 20 groups to lab test)
- Tops Market 50 samples (divided into 10 groups to lab test)

Spain

- Carrefour – 4 supermarket outlets - 200 samples

Australia

- Coles, Woolworths, Aldi - 305 samples (divided into 31 groups to lab test)

Labs were instructed to conduct two-stage testing:

1. To determine presence of bacteria in samples
2. If found, to culture ('grow') the bacteria to allow for antimicrobial testing

The following tests were performed. Note the focus for bacteria and antimicrobial resistance testing differed slightly between markets based on results of literature search.

a. Bacteria tested for:
    i. Salmonella (a key cause of food poisoning)
    ii. E-Coli (a very common bacteria with many strains)
    iii. Listeria (in relevant markets and usually found in chilled or frozen meat)
    iv. Enterococci (additional test if the lab recommended)

b. Antimicrobial testing for all the following classes of antibiotics as relevant to the above bacteria, including the 'highest priority' critically important to human health[57]:
    i. fluoroquinolones, (e.g. ciproxfloxacilin, enrofloxacilin)
    ii. polymycin (e.g. colistin),
    iii. cephalosporins, (third+ generation ones)
    iv. macrolides – (e.g. erythromycin, clindamycin)
    v. Glycopeptides (e.g. Vancomycin)

Additionally, some 'highly important antibiotics' to human health, also some of the most routinely used in animal health for decades:

c. Antimicrobial testing (as important to animal health use): and may include
    i. sulphonamides,
    ii. oxytetracycline
    iii. amoxicillin,

Labs were instructed to deliver a report noting whether the listed bacteria were present or not, and whether bacteria were "resistant" or "susceptible" to treatment with listed antibiotics based on clinical cut off points. Some labs also provided additional information about the resistant type E coli found.

Labs were also instructed to indicate where multi drug resistance (MDR) was found. MDR is resistance to at least one agent from 3 or more classes of antibiotics.

World Animal Protection calculated the extent of MDR in samples based on information provided by the lab reports.

References

[1] World Animal Protection, (2018) *World Animal Protection applauds Kroger on commitment to end use of gestation crates for pigs,* https://www.worldanimalprotection.org.au/news/world-animal-protection-applauds-kroger-commitment-end-use-gestation-crates-pigs

[2] Note that CP Group operations in China are currently excluded from this commitment. Reference: Williams, A, (2018) CPF steps up animal welfare improvements with global policy, *Global Meat News,* https://www.globalmeatnews.com/Article/2018/04/27/CPF-launch-global-animal-welfare-policy

[3] Antibiotics and antimicrobials are substances that kill or inhibit growth of microorganisms including bacteria. Whilst antibiotics are a subset of antimicrobials, the term "antibiotics" is used in in this report to broadly encompass substances of both natural and synthetic origin.

[4] The Review on Antimicrobial Resistance, (2014), *Antimicrobial resistance: Tackling a crisis for the health and wealth of nations,* Chaired by Jim O'Neill

[5] United Nations Environment Programme (UNEP), (2017) *Frontiers 2017 : Emerging Issues of Environmental Concern,* Nairobi

[6] Gundogan, N, Citak, S, Yucel, N, Devren, A, (2005) A note on the incidence and antibiotic resistance of Staphylococcus aureus isolated from meat and chicken samples, *Meat Science* 69(4): 807-810; Karmi, M, (2013), Prevalence of methicillin-resistant Staphylococcus aureus in poultry meat in Qena, Egypt, *Veterinary World,* 6(10), 711-715; Thai, TH, Hirai, T, Lan, NT, Yamaguchi, R, (2012), Antibiotic resistance profiles of Salmonella serovars isolated from retail pork and chicken meat in North Vietnam, *International Journal of Food Microbiology,* 156(2): 147-151; Zbrun, MV, Olivero, C, Romero-Scharpen, A, Rossler, E, Soto, LP, Astesana, DM, Blajman, JE, Berisvil, A, Signorini, ML, Frizzo, LS (2015) Antimicrobial resistance in thermotolerant Campylobacter isolated from different stages of the poultry meat supply chain in Argentina. *Food Control 57*: 136-141

[7] As of June 2018, private equity firm Advent International took a 80% stake in Walmart Brazil with Walmart Inc retaining a 20% stake.

[8] Backhans, A, (2016) Antimicrobial use in Swedish farrow-to-finish pig herds is related to farmer characteristics, *Porcine Health Management,* https://porcinehealthmanagement.biomedcentral.com/articles/10.1186/s40813-016-0035-0

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Above: Mother pig able to properly mother her piglets in a pen, not a cage. Straw allows pigs to explore and forage and also provides additional fibre in the diet.

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