Edible insects: applying Bakhtin's carnivalesque to understand how education practices can help transform young people's eating habits

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ABSTRACT

Western European populations are being encouraged to reconsider their diets in light of population growth and the intensification of meat production, to meet this growth. Health concerns associated with diets high in sugar, salt and saturated fat are also stimulating interest in alternative foods. Edible insects may be one option to help feed a growing population more sustainably, but this comes with its own challenges. This paper reflects on a pilot project introducing edible insects into primary and secondary schools in Wales, UK. Using Bakhtin's concept of the carnivalesque as a lens for reflection, the difficulties in introducing a novel food are considered and we provide an insight into how more sustainable, fringe practices may be framed in ways that allow them to be normalised.

Keywords: entomophagy; edible insects; attitude change, school, Bakhtin, carnivalesque

Introduction

The camera pans to the pale-faced celebrity, sweat glistening from their forehead, the wriggling, fat grub resting in their hand. Will they eat it?

First broadcast in 2002, 'I'm A Celebrity... Get Me Out Of Here!' has been a huge success for the UK channel, ITV. The programme is on its 16th series and regularly attracts millions of viewers. Popular reality television programmes, such as 'I'm a Celebrity…', create what literary theorist Mikhail Bakhtin would identify as a 'carnivalesque' experience (Bakhtin, 1984); an experience where anything is permitted, often with displays of excess and grotesqueness. The 'bushtucker trials' in the 'I'm A Celebrity…' jungle challenge participants to eat unusual and often unsavoury foods, creating a carnival ritual for the entertainment of others.

Although the term 'carnivalesque' was originally used in the literary analysis of medieval carnivals, it is a useful metaphor when considering challenges to socio-cultural norms. Carnivals represented a "second world and a second life outside officialdom" that provided a "completely different, nonofficial, extra ecclesiastical and extrapolitical" view of life

(Bakhtin, 1984 p6). Extending this lens to the jungle, contestants play out an alternative, carnivalesque space and are dared to eat insects and other invertebrates, which are often alive. Although insects are considered as novel food items in Europe (Regulation (EU) 2015/2283), the practice of eating insects in such a way destabilises the view of what, in many countries, is considered a traditional food. The practice of eating insects as a challenge can disrupt the place of insects in the usual social order (for example as a pest or pollinator) for the majority of Western European audiences (Laureati *et al.,* 2016; Megido *et al*., 2014). Thus, during ritual-like spectacles of television entertainment, social norms surrounding insects become subverted and begin to be understood through humor and repulsion - or 'grotesque realism'. Looy and Wood (2006) noted that such depictions of subverted social norms often create challenges for environmental educationists as they then need to unpack preconceptions to formulate more positive relationships and attitudes between humans and wildlife. But, why would we wish to subvert these preconceptions and bring entomophagy (eating insects) into the mainstream in the UK? This paper outlines the context of entomophagy before reporting on a pilot research project which introduced edible insects into four schools in Wales, UK. We present the approach of using the carnival as a lens through which to understand how the 'grotesque' food became more normalised and we consider how future research needs to be framed.

Environmental benefits associated with eating insects

In the absence of changes in farming practice, the environmental effects of the human food system are predicted to increase by 50-90% by 2050 when compared to 2010 . This level of change is said to be "reaching levels that are beyond the planetary boundaries that define a safe operating space for humanity" (Sprigmann *et al*., 2018a).

One of the options to reduce the environmental effects of food systems is dietary change (Springmann *et al*., 2018b). In 2015, the UK Government's Waste and Resources Action Programme (WRAP) reported that global meat consumption was expected to increase by 76% between 2000 and 2050 (WRAP, 2015). Research has identified that increased meat consumption can have a number of negative implications for the environment (Springmann *et al*., 2018a,b) and society (Wang & Beydoun, 1999). Erb *et al*. (2016) identify eating meat as the biggest contributing factor to food-related deforestation due to the amount of land required to be cleared to make way for pasture and crops used to feed cattle. The World

Resources Institute has reported that a decrease in the consumption of red meat (beef and lamb) would lead to between a 15-30% reduction in greenhouse gas emissions in the same period (Ranganathan and Waite, 2016). While the relative environmental impacts of vertebrate animal farming versus arable farming systems may vary spatially and temporally, reducing vertebrate meat consumption is generally seen as one way to eat more sustainably (Springmann *et al*., 2018a,b).

Including insects in our diet may be one type of dietary change that can help to reduce the negative environmental effects of our the food system. The Food and Agriculture Organisation of the United Nations (UN FAO) recognised the benefits of including insects in our diet. They urged the West to adopt the practice of eating insects as a sustainable food source (van Huis *et al*., 2013) as some insects are extremely efficient in converting feed into edible protein. For example, the ecological footprint of 1kg of protein from insects (in terms of greenhouse gas emissions and land use) is significantly lower than that of 1kg of protein from milk, beef, pork and chicken (Oonincx and de Boer, 2012). Crickets take between 12-25 times less feed, as well as significantly less water and land area, to produce the same amount of edible protein as cattle (van Huis *et al.,* 2013 and references therein). However, it is also recognised that, if the shift to including insects in our diets is to become an accepted reality, consumer attitudes must change.

Nutritional benefits associated with eating insects

Insects could become an important part of a healthy, balanced diet in Western cultures. Many edible insects provide satisfactory amounts of energy and protein with protein making up ≤77% of an insect's dry matter (Xiaoming *et al*., 2010); a protein content similar to beef (van Huis *et al.*, 2013). Many insects can meet amino acid requirements for humans (Bukkens, 2005), providing all nine essential amino acids. Some insects are high in monounsaturated and/or polyunsaturated fatty acids (Womeni *et al*., 2005), and many are rich in micronutrients such as copper, bioavailable iron, magnesium, manganese, phosphorous, selenium and zinc, as well as riboflavin, pantothenic acid, biotin and, in some cases, folic acid (Latunde-Dada *et al*., 2016; Oonincx *et al*., 2010). Therefore, it is sensible to look towards insects when investigating the potential to deliver positive change to the food system.

The school has been, and continues to be, a site of interest with regard to the complexities influencing young people and food. McIntosh *et al.* (2010) note that schools have been used as a context for policy intervention as they are seen as spaces where habits can be influenced and possibly changed through free school meals and breakfast clubs. Biopolitics tend to be played out **on** rather than **with** young people. For example with the introduction and ongoing implementation of the School Milk Scheme by the EU (in 1977) and later the School Fruit Programme in 2009 (Weible *et al.* 2013) schools become centres that influence the health of the young. They model 'good' practices to the next generation of consumers. For example, UK chef Jamie Oliver has addressed childhood obesity through attempted reforms of school lunch provision in the US (Gibson and Dempsey, 2015). A further example of intervention in the school context is the UK Government's first Childhood Obesity Plan (Cabinet Office, 2016) which launched in 2016. Obesity is having a significant impact on the economy: in 2011, obesity alone was estimated to cost the NHS in Wales £73m, with between £1.4m and £1.65m spent each week treating diseases resulting from obesity (*ibid*). The Childhood Obesity Plan was initiated due to growing concerns regarding the fact that nearly one-third of 2-15 year-olds were overweight or obese (Health and Social Care Information Centre, 2015). Interestingly, the first focussed intervention in the Plan was to raise young people's activity and encourage healthy eating through classroom and family workshops. By 2018, initial evaluations of the Plan by Birmingham University (Adab *et al.* 2018) reported no long-term impact of the intervention. It was recognised that, while the schools may be making changes to activity and learning opportunities, a reduction in childhood obesity would not be possible without wider support from the local authority and changes in, amongst other things, food acquisition policy. This finding echoes earlier work by Slawson *et al.* (2013), who note that additional research is still needed regarding how to maximise school nutrition services and engage local government staff. While educational research provides rich pickings in respect to widening understandings of food politics and health, research regarding food choices and sustainability in school, to our knowledge, is limited with Berghuis *et al.* 2018 commenting on University students.

With regard the specific focus of this paper, entomophagy has been dominated by adults' views and experiences with little consideration of young people under 13 years of age (e.g. (Laureati *et al*., 2016; Megido *et al*., 2014). Whilst there have been studies regarding power relations between young people and adults associated with school dinner choices more

generally (e.g. Pike, 2010), specific consideration regarding younger people's choice of food containing insects and the potential environmental consequences of their choices have, to the best of our knowledge, not been reported. Studies that focus on actually tasting insects and the acceptance of insects as food in Western countries are few and far between, (with notable exceptions e.g. Looy and Wood, 2006 and Megido *et al.* 2014, Sogari *et al*. 2017). However, the recommendations from theoretical research endorse a shift from forecasting acceptance to engaging with actual examples of consumption (House, 2016) and, while Megido *et al*. (2014) note that a shift to eating insects is becoming more fashionable, the yuk factor largely remains.

Methods

The project was designed to consider young people's attitudes to edible insects whilst also maximising wider stakeholder engagement, including the Local Authority, parents, teachers, school and catering staff. Whilst this project had a focus on edible insects, we also investigated young people's wider understandings of sustainability through the food chain. Within the school context, we used a standard workshop to investigate young people's attitudes to a meat alternative containing insect and plant protein called VEXo^{TM}. VEXo was developed specifically for school catering systems in the UK to reduce saturated fat, sugar and salt when compared to similar meat-based products while providing young people with important nutrients such asiron, iodine and riboflavin.

We sought to understand how young people made sense of a novel food that had wider nutritional, social and environmental benefits. The pilot study was undertaken in 2017-18 at three schools in Wales. The project cohort included year 2 (6-7 year-olds), year 4 (8-9 year-olds), and year 6 (10-11 year-olds) from two primary schools (N=124) and year 7 (11-12 year-olds) and year 9 (13-14 year-olds) from a secondary school (N= 63). The Local Authority had been approached previously regarding the project and were fully committed to supporting it. The Local Authority catering department sent out a call, via e-mail, for schools to volunteer to take part in the project. From those, three schools were chosen on the basis of similarities in geographical location and catchment – future work is planned to compare these aspects. It should be noted that some young people had previously visited Dr Beynon's Bug Farm (a local visitor attraction and research centre with a focus on invertebrates, run by one of the developers of VEXo). These individuals would have had the opportunity of tasting edible insects (though not in the form tested in school) in the onsite

restaurant Grub Kitchen (run by the other developer of VEXo). This prior exposure could have potentially biased responses in favour of, or against, entomophagy. As such, this pilot cannot be considered independent or fully representative of young people's attitudes, but is consistent with the purposes of qualitative research (Patton, 2002; Maxwell, 2013). The project provides an initial collection of useful perspectives to help develop a better understanding of young people's views of entomophagy and suggests new directions for future research.

The University of the West of England, Bristol, gave ethical approval. Consent to take part in the study was then gained from parents, and additional verbal consent was received from young people before any data were collected. Parental meetings were undertaken at each school to introduce families to the project prior to in-school workshops; information was shared, food tasted and opportunities for questions provided.

At the start of the workshop, each young person filled in a questionnaire to ascertain their current understanding of the topic of entomophagy and their feelings towards, and experiences about, eating insects. Each question was read verbally to ensure that everyone was able to access the language. The Likert scale of 1-5 (1 being strongly agree) was used, in addition to open-ended questions which gave an opportunity for greater personal reflection through either words or pictures.

Workshops (*c.* 45 minutes in length) were led by an entomologist and a chef - the founders of Bug Farm Foods (the company that developed VEXo). The advantages and disadvantages of different diets and farming practices were considered during a *c.* 20-minute presentation (with a slideshow) from the entomologist. During the presentation, VEXo was cooked by the chef in front of the young people. Immediately after the presentation, young people were invited to taste VEXo in two forms: a burger and a bolognaise. At this point it was made clear that there was no expectation to try the food. Small taster portions were placed on tables of between 6-8 young people. Adults then stood back to observe reactions. At the end of the session, a further questionnaire was filled in to capture changes in attitudes and current understanding of, and desire to learn more about issues relating to sustainable development. In addition to this, focus groups lasting *c.* 30 minutes were undertaken with six young people from each class, chosen by the teacher, allowing more qualitative feedback and evaluation. The focus groups also gave time for

young people to co-plan what an educational resource might include, as well as question their attitudes towards education for sustainable development in school further.

The possibility of including edible insects onto a school education and catering programme was investigated. Semi-structured interviews of *c.* 30 minutes were conducted with teaching staff and members of the senior leadership team to consider the usefulness of planned educational resources and their confidence in teaching in this subject area. Having made amendments based on young people's and staff input, resources were then distributed to schools. Follow-up with teachers and young people was made four weeks later to discuss if / how they had impacted on teaching and learning and reflect on results to date with participants. Initial findings from this pilot project were considered in order to aid in our understanding of the broader topic and drive further research.

Analysis

We used a mixed method evaluative approach based on interpretivist theory – whereby it is suggested that the impact of the programme is constructed from the meanings the participants make of their experiences (Schwandt, 2003). Here we report findings of this project in line with recommendations made by O'Brien *et al*. (2014).

All focus groups and interviews were transcribed and coded using content analysis defined by Patton (2002) as "any qualitative data reduction and sense making effort that takes a volume of qualitative material and attempts to identify core competences and meanings". In this case, a thematic analytical framework around interest, taste feedback and changes in opinion were analysed with the assistance of NVivo12. All participants were coded (e.g. P4PT2) to provide anonymity.

Multiple aspects of the way in which participants described their reaction to the engagement with the new product were then considered in association with Bakhtin's (1984) carnivalesque. We propose that this lens offers insights into ways that the development of environmental understandings at the edge of acceptance can be negotiated. In identifying the characteristics of the carnivalesque from the data, we looked at how engagement with the 'grotesque' can be negotiated into the mainstream. Thus, we propose that this provides an opportunity to reflect on the introduction of what might be socially unacceptable, yet

sustainable practices, and apply them to future classroom practice and possible wider social change.

Results

One hundred and twenty-four young people from primary school (ages 6-11 years) and sixty-three young people from secondary school (ages 11-14 years) took part in workshops.

Sixty four percent of questionnaire responses and 100% of focus group attendees did not wish to see actual parts of insects in their food but preferred the processing and presentation of VEXo in familiar formats (bolognaise and burger). Young people consistently talked about the tasters looking 'normal' and 'nothing different' to the extent that in five of the eight focus groups respondents commented similarly to P4PT2:

"Just don't tell anyone it's got bugs in; they would never know. It's delicious!"

After tasting the product, 74% of young people were positive about its taste, with 54% of those reporting it was tastier than expected. One hundred percent of comments relating to the taste of VEXo bolognaise were positive, with all negative comments on taste referring to the burgers. This post-tasting change, when discussed further in focus groups, was consistently linked to the reduction in initial fear once they had seen VEXo, watched it being cooked and then there being no pressure to actually try it if they did not wish to: young people were given the autonomy to choose without consequence and so felt empowered, as the responses below highlight:

> P5PP "If adults had been standing over me like they usually do and encouraging me to eat, I probably wouldn't have even tried it. I chose to, for me. It was nice, not nearly like what I thought it'd be like, yeah."

> P1PS4 "If teachers had been there pressurising me to eat it, I wouldn't have done it out of principal … there was no real, like … expectation to try it and that was really good."

The positive opinion of having the opportunity of choice was further reinforced when considering the response in questionnaires about whether young people would choose

VEXo for school lunch if it were offered. Before the workshop and tasting sessions 27% of young people reported that they would choose products containing insects for school lunch: this raised to 56% after the workshop and tasting session. With school dinner take-up being around 50% for those schools taking part in the pilot project, this provides an initial indication that the introduction of such food may have the ability to increase school dinner take-up when compared to current take-up.

With regard to the development of educational resources, in the questionnaires after the workshops, 80% of young people noted that they wished to learn more about sustainable development. In focus groups, a number of participants talked about how they felt they learnt very little if anything about sustainability at school. A number echoing P1PS6 comment:

> We all know that looking after the planet is important – right. But we don't learn about what we can actually do to make a difference [at school]. This [VEXo] is real. We can actually make changes to what we eat and that might actually make a difference.

Teachers and senior leaders all reported that they could identify ways in which the topic had 'sparked so much discussion and engagement' (Teacher T2B) and could be embedded further into teaching. During focus group discussions, young people agreed the following should be included in future learning activities:

- edible insect farming practices – how they are looked after and killed
- the ecological footprint of different foods to make comparisons with edible insects
- the health benefits of different foods to make comparisons with edible insects
- the opportunities to cook with edible insects and learn more about the health / nutritional benefits of edible insects.

Teachers echoed young people's desires to want to learn more about methods of farming and health impacts of different foods and were keen to use data from the workshops in related lessons of maths and geography. As a result of young people and teacher discussions, these suggestions were written into the resources that were later circulated to teachers.

All teachers involved in the project were positive about developing more learning opportunities in their classrooms related to the themes of the workshop and the resources provided. The teachers all recognised the need to develop rich learning opportunities in order to develop learning models that reflected the new curriculum for Wales as outlined in the Donaldson Report (2015). Primary school teachers identified links with their planned summer term themes of 'minibeasts' and 'living things', whilst the secondary school planned to further embed learning through a dedicated cross-curricular 'sustainable week' (during which, VEXo was offered on the lunch menu in the canteen). Links to the new GCSE biology syllabus were also identified as well as links to the BTEC in agriculture. Compared to before the workshops, all teachers reported that they felt more engaged and able to teach about edible insects after the workshops and after having received the resources. However, the actual engagement after this intervention requires more interrogation and is outside the remit of this paper.

Discussion

In this project, shifts in acceptance of a sustainable and novel food were observed. Using Bakhtin's carnival lens as a foundation, it became apparent that the themes emerging from the data could be interpreted and discussed. In doing so, we begin to unpack how perceived socially unacceptable or fringe activities can potentially move from liminal spaces to acceptable practice in the mainstream. In this case, the acceptance of an unfamiliar food product supported Education for Sustainable Development in the classroom and triggered a desire to learn more by young people and teachers alike. Like Galen D'Amato and Krasny (2011), we propose that an existing theory can be used to better understand the implications of emerging themes.

Bakhtin (1984) identifies various behaviors of carnival which are pertinent to consider in this discussion:

- the way it permits bold behaviours whilst featuring the grotesque and behaviours around the grotesque;
- the way it enables members of the group to entertain;
- the way it brings people together who would normally not meet;
- and the way it unites opposites.

Initial responses to the prospect of eating edible insects showed a mixture of unease and uncertainty. Young people made comments like ‘gross’ ‘disgusting’ and ‘grotesque’ yet often with a note of relish in their voice and smile on their face. As in carnival, this ‘other’ was embraced through a playful atmosphere of daring and bravado. The act of enjoying the session was a reoccurring theme in the feedback. Ninety eight percent of questionnaires returned reported that young people had “enjoyed the session very much” and “[enjoyed the session] far more than expected”. Offering a session to familiarise young people with new food, amongst peers, within friendship groups and without fear of retribution from authority figures (i.e. not being told they have to try it), was important in the normalisation of novel food.

Bakhtin (1984) talks about the carnival as a space of celebration and performance and this was an important aspect in the design of the workshop in relation to the cooking of VEXo. The spectacle was considered important by the young people; seeing VEXo being cooked was commented on positively in all focus groups. Whilst the theme of edible insects in itself was novel, a sense of playfulness was also developed: for example, the chef / food developer commented that he was “putting on his chef costume” at the point of food preparation. This simultaneously brought an element of both performance and expertise to the workshops where different groups (young people, entomologists, chefs, food developers) not usually associated with each other, could meet. This swapping of roles was also experienced by the young people; initially seeing themselves as unknowledgeable about eating insects and then becoming the expert consumers able to evaluate and feed back their thoughts and opinions to food developers. The chef shifted from confident preparer of food to requiring the knowledge and experience from the young people in his role as food developer. In this way, the normal authority of a school lesson was temporarily inverted; young people had the power to try, or not to try, the tasters; they had the power to accept, or reject, and to be bold in their decisions. Thus, the young people’s expected and realised experience of the workshops - and later focus groups – shifted as they moved between the visiting ‘experts’ being the authority, to the authority being themselves.

Previous research has explained the aversion that adult European consumers show for insects as food in relation to disgust and neophobia (Hartmann *et al.* 2015, La Barbera et al. 2018, Martins and Pliner 2006 , Ruby *et al.* 2015, van Huis *et al.* 2013, Verbeke, 2015, Verkerk *et al.* 2007). Neophobia is a universal construct which refers to a tendency to avoid

unfamiliar food. While we have not implemented Pliner and Hobden's (1992) Food Neophobia Scale to this case, it can be noted that other research has shown food neophobia to significantly and negativelty affect adults' willingness to eat insect based food (Alemu *et al*., 2015, Pedersen, 2014, Tan *et al.* 2016, Verbeke, 2015). In addition to this, factors eliciting disgust have been noted as being different across and amongst individuals and cultures (Herz 2012, Mignon 2002).

The normalisation of what is considered 'grotesque' is essential to the acceptance of edible insects if we are to incorporate them in our diets here in the Western world. Rozin and Fallon's (1980) work on the rejection of new food notes that the consumer can be repelled by the unknown or assumed 'dirty' or 'nasty' nature of a new food, in this case an insect's habitat or behaviour. Additionally, the consumer can have an unfounded, yet anticipated, feeling of un-wellness should the food (insects) be consumed and these characteristics make for the 'grotesque'.

In agreement with our findings, a number of studies suggest that improving acceptance of edible insects lies in processing and incorporating them, as ingredients into familiar consumer products (Megido *et al.,* 2016; Menozzi, *et al*., 2017; Pascucci & de-Magistris, 2013; Sogari, *et al.* 2017). This project used familiar-looking, yet insect-containing products (bolognaise and burgers): due to the processing of the insects, there were no recognisable insect parts in VEXo. Thus, it was hoped the potential for neophobia was reduced and the food could become normalised.

> P8TP: 'But it looked just like normal bolognaise'
> P4TP: Yea, it's like what I had for tea last night … and there was definitely bugs in there?
> Researcher: Yes
> P4TP: and it's better for the planet and lots healthier? … then I just wouldn't tell anyone it's got bugs in … they'd never know.

The above focus group comments highlight how the processing of the food normalised the experience and made it acceptable. Referring back to the comment that we 'just don't tell anyone it's got bugs in; they would never know' also reflects on the accepted power

relations young people expect with their (school) meals. They acknowledge their mediated agency in the choices they are able to make.

This normalisation was further amplified when young people reflected on the workshop within which the insect content of familiar, everyday foods was shared with them – such as 100g of chocolate can contain, on average, 30+ parts of insects (Gates, 2017). Shifting the perceived unusual and grotesque practice of eating insects, to a possibly everyday (albeit unknown) occurrence was reassuring for many young people and further reinforced a shift towards normalisation.

Conclusion

This pilot project has begun to explore the current context of introducing entomophagy to young people (ages 6-14 years) in school and how, by working with schools (their teachers and pupils) within the UK, practices in education could be used to invert the negative social and cultural preconceptions associated with eating insects that many have in the West. The project has gained initial, child-centered data and has enabled pupils and staff to be involved in reconsidering their own understanding through the workshops provided, as well as in the co-development and implementation of educational resources (see Jones, 2019 for discussion of classroom pedagogy associated with the findings).

Using the carnival as a lens through which to consider behaviour change, this pilot project, and the wider research programme, tries to move beyond the eating of insects as seemingly grotesque. The project attempts to provide a methodology within which edible insects are reconsidered; subverting what is at the fringe and bringing it to centre stage.

If we, in Western Europe, are to seriously consider shifting our diets to include edible insects and move away from the traditional vertebrate meat protein sources, then we need to consider the practice through which this change is enabled. We need to question whether introducing a novel food can inspire and excite young people about healthier food choices and diets that are also more environmentally sustainable. In particular, as new products become available, we need to consider what young people think about them through a gastro-environmental lens. If Local Authorities are steering food choices then how can we support interventions that provide young people agency and opportunities to (re)negotiate their understandings?

Further planned research, on a larger scale, will offer additional ways of looking at issues associated with subverting views on previously considered unsavory foods towards reframing them as healthy (as part of a balanced diet) and environmentally sustainable. It will be necessary to follow-up on themes associated with young people's choices: in particular, choice driven not by taste or cost, but sustainable and ethical credentials. It will be necessary to consider the longer-term consequences of whether a method like the one presented here could trigger more interest in topics of sustainable development, as well as create changes in eating habits (Jones 2019). Viewing the introduction of novel foods through the lens of the carnival allows us to articulate young people's behaviour change. Subverting what was unacceptable and relocating it to the classroom shows promising signs that new relationships between young people and sustainable, healthy food can be developed.

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References:

Adab, P., Pallan, M,. Lancashire, E. Hemming, K., Frew E. & Barrett T. (2018) Effectiveness of a childhood obesity prevention programme delivered through schools, targeting 6 and 7 year olds: cluster randomised controlled trial (WAVES study) *British Medical Journal*; 361

Alemu, M. Olsen, S., Vedel, S., Pambo, K., Owino, V. (2015) Consumer acceptance and willingness to pay for edible insects as food in Kenya: The case of white winged termites (No. 2015/10) University of Copenhagen, Department of Food and Resource Economics.

Bakhtin, M. (1984). *Rabelais and his World*. Bloomington, Indiana University Press.

Berghuis, N., Plourde, H., Lauzon, M. & Hendrickson, M. (2018,), Nudging Nutritious and Sustainable Food Choices in University Dining Halls", *Journal of the Academy of Nutrition and Dietetics,* 118: 9, A78-A78.

Bukkens, S. G., & Paoletti, M. G. (2005). Insects in the human diet: nutritional aspects. *Ecological implications of minilivestock; role of rodents, frogs, snails, and insects for sustainable development*, 545-577.

Cabinet Office (2016) Childhood Obesity: a plan for action, Department of Health and Social Care, HM Treasury. https://www.gov.uk/government/publications/childhood-obesity-a-plan-for-action [16.05.19]

Donaldson, G. (2015) Review of Curriculum and Assessment Arrangements in Wales http://learning.gov.wales/news/sitenews/successful-futures/?lang=en (Accessed 06.01.19)

Erb, KH., Lauk, K., Kastner, T., Mayer, A., Theurl, MC., & Haberl, H. (2016). Exploring the Biophysical Option Space for Feeding the World without Deforestation*, Nature Communications,* 7 (11382) http://www.nature.com/articles/ncomms11382 [last accessed 16.7.18]

Galen D'Amato, L., &. Krasny, M.E, (2011). Outdoor Adventure Education: Applying Transformative Learning Theory to Understanding Instrumental Learning and Personal Growth in Environmental Education, *The Journal of Environmental Education*, *42* (4), 237-254

Gates, S. (2017) *Insects, an edible field guide*, London, Ebury Press.

Gibson, KE. & Dempsey, SE. (2015) Make Good Choices, Kid: biopolitics of children's bodies and school lunch reform in Jamie Oliver's Revolution, *Children's Geographies*, 13 (1) 44-58

Hartmann, H., Shi, H., Giusto, A., Siegrist, M. (2015) The psychology of eating insects: A cross-cultural comparison between Germany and China, *Food Quality and Preference*, 44, 148-156

Health and Social Care Information Centre (2015) *Health Survey for England 2014*, NHS https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/health-survey-for-england-2014 [Last accessed 11/1119]

Herz, R. (2012) *That's disgusting: Unraveling the mysteries of repulsion*, WW Norton & Company.

House, J. (2016) Consumer acceptance of insect-based foods in the Netherlands: Academic and commercial implications. *Appetite*, *107*, 47-58.

Jones, V. (2019) Adapting our diets for global climate change: could eating bugs really be an answer? *Teaching Geography*, *(*summer) 72-74

La Barbera, F., Verneau, F., Amato, M., Grunert, K. (2018) Understanding Westerners disgust for the eating of insects: the role of food neophobia and implicit association, *Food Quality and Preference*, 64, 120 – 125.

Latunde-Dada, G. O., Yang, W., & Vera Aviles, M. (2016). In vitro iron availability from insects and sirloin beef. *Journal of agricultural and food chemistry*, *64*(44), 8420-8424.

Laureati, M., Proserpio, C., Jucker, C., & Savoldelli, S. (2016) New sustainable protein sources: Consumers' willingness to adopt insects as feed and food*, Italian Journal of Food Science, 28*(4), 652-668.

Looy, H. & Wood, J. (2006). Attitudes toward invertebrates: Are educational "bug banquets" effective? *Journal of Environmental Education* 37(2) 37-48

McIntosh, I., Emond, R. & Punch, S. (2010) Discussant piece: food and schools, *Children's Geographies, 8* (3) 289-90

Martins, M., Pliner, P. “Ugh! That's disgusting!”: Identification of the characteristics of foods underlying rejections based on disgust, *Appetite*, 46 (1) (2006), 75-85

Maxwell, J. A. (2013). *Qualitative Research Design: An interactive approach*, Thousand Oaks, 3rd edition, CA: Sage.

Megido R., Gierts, C., Blecker, C., Brostaux, Y., Haubruge, É., & Alabi, T. (2016) Consumer acceptance of insect-based alternative meat products in Western countries, *Food Quality and Preference,* 52, 237-243.

Megido, R.C., Sablon, L., Geuens, M., Brostaux, Y., Alabi, T., Blecker, C., Drugmand, D., Haubruge, E. & Francis, F. (2014) Edible Insects Acceptance by Belgian Consumers: promising attitude for entomophagy development, *Journal of Sensory Studies 29*, 14–20

Menozzi, G. Sogari, M. Veneziani, E. Simoni, & C. Mora (2017) Eating novel foods: An application of the theory of planned behaviour to predict the consumption of an insect-based product, *Food Quality and Preference*, *59*, https://www-sciencedirect-com.ezproxy.uwe.ac.uk/science/article/pii/S0950329317300319 [last accessed 16.05.19]

Mignon, J. (2002) L'entomophagie: une question de culture? *Tropicultura,* 20, 151-156.

O’Brien, B., Harris, I., Beckman, T., Reed, D., Cook, D. (20014) Standards of Reporting Qualitative Research: a synthesis of recommendations, *Academic Medicine*, 89(9), 1245-1251

Oonincx, D. G., & De Boer, I. J. (2012). Environmental impact of the production of mealworms as a protein source for humans–a life cycle assessment. *PloS one*, *7*(12), e51145.

Pascucci, S., & de-Magistris, T. (2013) Information bias condemning radical food innovators? The case of insect-based foods in the Netherlands, *International Food and Agribusiness Management Review*, *16* (3), 1-16

Patton, M. Q. (2002) *Qualitative research & evaluation methods*, Thousand Oaks, CA: Sage

Pedersen, J. (2014) Disgusting or delicious, *EuroSense, A sense of life*, University of Copenhagen.

Pike, J. (2010) 'I don't have to listen to you! You're just a dinner lady!': power and resistance at lunchtimes in primary schools, *Children's Geographies*, 8(3)

Ranganathan, J. & Waite, R. (2016), Sustainable Diets and What You Need to Know, World Resource Institute http://www.wri.org/blog/2016/04/sustainable-diets-what-you-need-know-12-charts [last accessed 16.07.18]

Rozin, P., & Fallon, A. (1980) The Pyschological Categorisation of Foods and Non Foods, *Appetite* (*1*) 193-201

Ruby, M., Rozin, P., Chan, C. (2015) Determinants of willingness to eat insects in the USA and India, *Journal of Insects as Food and Feed*, 1:3, 215-225

Schwandt, T. 2003. "Three epistemological stances for qualitative inquiry". In *The landscape of qualitative research: Theories and issues*, Edited by: Denzin, N. and Lincoln, Y. 189–213. Thousand Oaks, CA: Sage Publications

Slawson, D. L., Southerland, J., Lowe, E. F., Dalton, W. T., Pfortmiller, D. T., & Schetzina, K. (2013). Go slow whoa meal patterns: Cafeteria staff and teacher perceptions of effectiveness in winning with wellness schools. *Journal of School Health*, *83(*7), 485–492.

Sogari, G., Menozzi, D., & Mora, C. (2017) Exploring young foodies' knowledge and attitude regarding entomophagy: A qualitative study in Italy**,** *International Journal of Gastronomy and Food Science, 7*, 16-19.

Springman, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Bodirsky, B. L., Lassaletta., L., de Vries, W., Vermeulen, S. J., Herrero, M., Carlson, K. M., Jonell, M., Troell, M., DeClerck, F., Gordon, L. J., Zurayk, R., Scarborough, P., Rayner, M., Loken, B., Fanzo, J., Godfray, H. C. J., Tilman, D., Rockström, J., & Willett, W. (2018a) Options for keeping the food system within environmental limits. *Nature*, 562, 519-525.

Springman, M., Wiebe, K., Mason-D'Croz, D., Sulser, T., Rayner, M., & Scarborough, P. (2018b) Health and nutrition aspects of sustainable diet strategies and their association with environmental impacts: a global modelling analysis with country-level detail. *The Lancet*, *2*(10), PE451-E461.

Tan, H., Fischer, A., van Trijp, H., Stieger, M. (2016) Tasty but nasty? Exploring the role of sensory-liking and food appropriateness in the willingness to eat unusual novel foods like insects, *Food Quality and Preference*, 48, 293-302

UK Government (2017) Childhood Obesity: a plan for action, https://www.gov.uk/government/publications/childhood-obesity-a-plan-for-action/childhood-obesity-a-plan-for-action updated 20.01.17 *[*last accessed 07.11.18*]*

van Huis, A. Van Itterbeeck, J. Klunder, H. Mertens, E. Halloran, A. Muir, G. Vantomme, P. (2013) Edible Insects: future prospects for food and feed security, FAO Forestry Paper, 17, pp. 1-154 https://library.wur.nl/WebQuery/wurpubs/fulltext/258042 [last accessed 16.05.19]

Kleef, v., E, Vrijhof, M.N., Polet, I.A., Vingerhoeds, M.H. & Wijk, d., R.A 2014, "Nudging children towards whole wheat bread: a field experiment on the influence of fun bread roll shape on breakfast consumption", *BMC Public Health,* 14:1, 906-906.

Verbeke, W. (2015) Profiling consumers who are ready to adopt insects as a meat substitute in a Western society, *Food Quality and Preference*, 39, 147-155

Verkerk, M., Tramper, J., Van Trijp, J., Martens D. (2007) Insect cells for human food, *Biotechnology Advances*, 25:2, 198-202

Wang, Y., & Beydoun, M. A. (1999) Meat consumption is associated with obesity and central obesity among US adults. *International Journal of Obesity*, 33, 621-628

Weible, D., Salamon, P., Inken, B., Christoph-Schults, G. (2013) How do political, individual and contextual factors affect school milk demand? Empirical evidence from primary schools in Germany, *Food Policy*, 43, 148-158.

Womeni, H. M., Linder, M., Tiencheu, B., Mbiapo, F. T., Villeneuve, P., Fanni, J., & Parmentier, M. (2009). Oils of insects and larvae consumed in Africa: potential sources of polyunsaturated fatty acids. *Oléagineux, Corps gras, Lipides*, *16*(4-5-6), 230-235.

WRAP (2015) *Food Futures: from business as usual to business unusual*. http://www.wrap.org.uk/sites/files/wrap/Food_Futures_%20report_0.pdf [25.05.19]

Xioming, C, Ying, F., Hong, Z., & Zhiyong, C. (2010) Review of the nutritive value of edible insects. Forest insects as food. *Humans bite back*, *85*, 87-98