REVIEW OF FOOD WASTE MANAGEMENT IN SCOTLAND: A CASE STUDY

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ABSTRACT

In Scotland and the UK, food waste from industrial kitchens is commonly disposed to sewers via Food Waste Disposers (FWD). Consequently, each year thousands of tonnes of macerated food enters into sewage treatment works. Apart from the obvious impact on the environment, such as excessive water use and effluent discharges, there is concern about the spread of disease. Whilst, the Animal By-product Regulations safeguard health by preventing catering waste containing meat being fed to animals or spread on land, it does not cover its disposal to sewers. Scottish sewage treatment works are operating at full capacity, and to meet new legislative requirements, refurbishment is required. Although FWD are either banned or extensively restricted in most European countries, no such restrictions exist in the UK. An alternative sustainable approach of dealing with food waste is required. This paper discusses the impacts associated with FWD, using the National Health Service in Scotland (NHSS) as a case study. Regulation of this type of disposal needs to be standardised across the EU.
Keywords: *Food Waste Disposers (FWD), Pathogens, Trade Effluents, Waste legislation.*

INTRODUCTION

A high proportion of food produced for human consumption is unused or rejected, such as uneaten and inedible meals, peelings, trimmings, and scrapings from food. Discarded food can include meat, poultry, seafood, dairy products, pastries, vegetables, etc. Most food waste generated in UK catering outlets (hotels, restaurants, healthcare and educational canteens) is macerated and evacuated into the sewers. During 2002 UK catering outlets purchased 400,000 tonnes of raw meat products, around 1.1% of raw meat purchased by caterers, (blood, gristle, rind and fat) is discarded prior to cooking (Gale, 2002). If this portion of raw meat is disposed of via the drain along with other food wastes from commercial kitchens, up to 4,400 tonnes of raw meat could be entering into the sewage system each year. Food wastes, particularly raw or undercooked items, can contain pathogens with a broad range of host species including mammals, birds, and fish. If these pathogens are released into the water system it could increase the risk of disease within selected host species. Potentially, this method of waste disposal could provide a pathway for the spread of disease into the food chain. The UK needs to review its waste strategy, and adopt more sustainable methods of managing food waste such as composting or energy recovery. In order to demonstrate the impacts associated with FWD this paper concentrates on the National Health Service in Scotland (NHSS).

MATERIALS AND METHODS

A detailed survey of food waste generation and disposal across one NHSS Trust was taken, and confirmed during interviews with key personnel from other Trusts. Results indicated around 30% of food waste was a fairly consistent figure throughout NHSS, and the disposal of food waste to sewers is standard NHSS policy. A typical 400-bed hospital was chosen as a comparative sample area. Using the 'Modgen Formula' a figure of 7812 m^3/year of Trade Effluent

Volume (TEV) per sample area was reached The average weight of a main meal is 800grammes, and the operating costs of FWD are as follows: Water: £0.68/m^3, TEV: £2.45/ m^3 (higher strength rate), Energy: £45.00/MWh (Fernand, 2003).

RESULTS AND DISCUSSION

NHSS: Food Production and Disposal

NHSS produce 28million meals per year to patients in 220 hospitals. NHSS annual purchases include, 2,000 tonnes of bread, butter and potatoes, 3,400 tonnes of raw meat and poultry, and 4.8million litres of milk and fruit juice (NHS, 2004). An analysis of results from a recent survey on catering waste across 50% of the NHSS (Audit Scotland, 2003) indicates on average 17% of patient meals are surplus to requirements and discarded. A further survey on food waste across one NHSS Trust, revealed around 30% of food waste arises as leftovers from meals served to patients (Fernand, 2003). Subsequently, almost half of the 28million meals produced by NHSS are consigned to the sewers. Food waste from meals served to NHSS staff and visitors are not included in this paper or in the above-mentioned surveys. However it should be noted, NHSS employ 115,000 staff and treat up to 30,000 in-patients a day. Leftovers from the high uptake of 'subsidised meals' served to staff and patient's visitors are also disposed of via the drain.

Operational Impact and Costs Associated with FWD

FWD require an average of 11.4 litres of water to shred and dispose of 1 kilogram (kg) of food waste (Diggelman and Ham, 1998; Harman, 2000). Assuming 1 kg of food waste displaces approximately 1 litre of water, the Trade Effluent Volume (TEV) from FWD is estimated to be 12.4litres/kg. Energy requirements of FWD are 0.0196kWh/kg (CRC, 2000). Table 1 provides an indication of the impacts and costs associated with FWD, based on 25% and 50% of wastage from the 28million meals/year produced by NHSS. Based on 50% of food wastage rates, TEV costs from FWD would account for almost 16% of NHSS total annual TEV costs of £2.2million. Nonetheless, FWD currently offer the cheapest and most convenient form of waste disposal in Scotland; local authority waste collection and disposal costs for landfill or composting average at around £70/tonne (SEPA, 2003), whereas FWD costs average at £39/tonne (Fernand, 2003). Hence, there is no financial incentive for NHSS to adopt an alternative practice.

Table 1*: Scenarios of annual operational impact and costs of FWD in NHSS.*

Rate of Food Waste from meals [%]	**25%**	**FWD Costs (£)**	**50%**	**FWD Costs (£)**
Total Waste Arisings [t/a]	5,600	-	11,200	-
Water Consumption [m^3/a]	63,840	43,412	127,680	86,823
Trade Effluent Volume [m^3/a]	69,440	170,128	138,880	340,256
Energy Requirement [MWh/a]	110	4,950	220	9,900
Total Costs (GBP)	**-**	**£218,490**	**-**	**£436,978**

Impact of Organic Water Pollution from FWD.

There is a lack of reliable data available on the impacts associated with FWD. However, results from three separate studies (CRC, 2000), which analysed the impacts of FWD using various techniques, are shown in Table 2. Prior to discharging wastewater from Sewage Treatment Works (STW), Scottish Water must try to achieve the following discharge quality standards: SS-45mg/litre, BOD-25mg/litre and COD-125mg/litre (Scottish Water, 2004).

***Table 2**: Quality of Effluents from FWD, based on previous studies.*

SOURCE	TECHNIQUE	SS (mg/l)	BOD (mg/l)	COD (mg/l)	O&G (mg/l)
NYC, Late 1990's (New York)	Predictions from monitoring sewers	5,634	8,078	12,128	707
Sinclair Knight,1990 (Australia)	Based on generic literature analysis	6,356	4,000	-	*11,500
De Koning & van der Graaf, 1996 (Netherlands)	Based on theoretical chemical composition of food	10,667	11,648	16,889	-

*SS: Suspended solids, BOD: Biological Oxygen Demand, COD: Chemical Oxygen Demand, O&G: Oil and Grease. * Average.*

The severity of organic pollution from FWD is dependant on the type and amount of waste disposed, the level of treatment at STW and the quality of receiving waters. Industrial FWD macerate food into particle sizes of around 2mm. This increases levels of foaming and scum formation in STW, and increases the organic load of sewage effluents, a major cause of eutrophication in UK Rivers. Grease traps often fail to capture the additional oils and fats contained in food; this increases the occurrence of localised sewer blockages, and interrupts normal sewage treatment processes (Scottish Water, 2003). The sewerage undertakers do not recommend FWD, particularly in areas such as Scotland that employ combined sewage systems. Under the Urban Waste Water Treatment (Scot) Regs.1994, during abnormal conditions (emergency or flood periods), authorised Combined Sewage and Stormwater Overflows (CSO's), allow water authorities to pass raw sewage through 6-10mm screens, and discharge sewage effluents into the aquatic environment. In Scotland, many STW are dated and require renovation. During 2003, Scottish Water reported over 400 unauthorised or unsatisfactory CSO's required attention, as visible raw sewage and sanitary litter was intermittently being discharged into rivers (Scottish Water, 2003). Sewage is the largest source of inland water pollution; several rivers in Scotland are consistently impacted by sewage-derived debris from storm events, and more frequently from spills of CSO's (SEPA, 2003). During 2000, 12% of samples collected from Scotland's public sewage outlets failed to meet the relevant trade effluent standards. During the same period 15% of Scotland's 60 designated bathing beaches failed to meet the lower EU Bathing Water Quality Standard (Scottish Executive, 2004). The disposal of food waste into sewers increases the organic load of sewer effluents and the risk of disease in the aquatic environment.

Potential Spread of Pathogenic Disease via FWD

Pathogenic diseases can display diverse characteristics since the causative organisms may be viral, bacterial, fungal, protozoal, or parasitic. Infections in humans can arise from a variety of routes such as foodborne, waterborne, direct contact, and via insect vectors. In the UK, the most common source of infection is thought to be foodborne, but drinking water, sewage waste and food handlers also act as vehicles of infection, as illustrated in Table 3. Although animals and plants may appear healthy, their meat, eggs, milk, leaves or other products may be contaminated with pathogens. For example, 86,000 cases of foodborne illnesses and 7,000 cases of waterborne cryptosporidious were recorded in the UK during 2001. However, these figures are only the 'tip of the iceberg'. Many foodborne infections are not legally notifiable in the UK. Additionally, some pathogens transmitted through food, can also spread through water, thus foodborne transmission is not always detected. Some pathogens, such as Salmonella, Campylobacter, E-coli 0157:H7, and Listeria, are even able to survive outside their hosts in water; subsequently recreational water users may also be at risk from contaminated waters. It is likely around 5.5 million people (1 in 10) in the UK can suffer from foodborne illness each year (FDF, 2004).

***Table 3**: Common Foodborne and Waterborne Pathogens*

BACTERIUM	VEHICLES OF INFECTION
Campylobacter:	Poultry, raw meat, unpasteurised milk, untreated water, sewage, food handling
Salmonella:	Raw meat, poultry, eggs, ra w veg, unpasteurised milk, food handling, sewage
E.Coli:	Raw /undercooked meat, unpasteurised milk, vegetables, apple juice, sewage
C. Perfringens:	Raw meat, poultry, poorly refrigerated food, sewage
Listeria:	Unpasteurised milk, fresh meat, soft cheese, salads, cabbage, poultry, sewage
Bacillus Cereus:	Rice, pasta, meat, veg, soups, sauces, unrefrigerated cooked foods
Staphylococcus:	Vegetables, fish, poultry, meats, under processed, low acid and vacuum pack foods

Infectious symptoms range from mild gastroenteritis to life threatening neurological, hepatic and renal syndromes. A recent survey of foodborne pathogens sampled 4,866 fresh and frozen chickens from UK retailers; 50% were found to be campylobacter positive, and 5.7% were salmonella positive (DEFRA, 2003). Major notifiable diseases such as BSE, vCJD and VTEC 0157 are now generally recognised as being meat related. Consequently, in 1996 the feeding of mammalian meat or bone meal to farmed animals became illegal. In order to further safeguard human and ecological health, it is also now prohibited to allow livestock (including wild birds) access to catering waste containing meat, or meat products of animal origin. In the UK, however, the disposal of catering waste containing meat, or meat products into sewers continues to be an acceptable practice, even though it could increase the spread of pathogens in the aquatic environment. Considering insect vectors, birds, fish, rodents and other small animals have access to inland waters, if these waters are pathogen-infected, they would potentially act as pathways for the spread of disease into the food chain.

UK Legislation Pertaining to Food Waste Disposal

The EU Landfill Directive (LD) requires that the landfilling of biodegradable waste must be systematically reduced in accordance with set targets over the next decade. To help meet LD targets, the proposed Biowaste Directive intends to ensure that biowastes are biologically treated, and the energy or value contained in the waste is utilised prior to disposal. A major aspect of current proposals has been the European Commissions (EC) recommendation to ban FWD in all Member States (CECED, 2003). Whilst FWD are already banned or extensively restricted in many European countries, no such restrictions exist in the UK. Although the EC recommend a ban on FWD, it is not within their jurisdiction to enforce such a ban. The Animal By-Products Regulations, permits the use of composting and biogas treatments of catering wastes or low risk category 3 animal by-products, but to safeguard human and animal health it requires for waste to be sanitised at temperatures of at least 60°C for 2 days in a closed container. Under the Water Industry Act 1991, premises disposing of catering wastes via the drain only require full consent from water authorities if they are disposing of more than 1 m^3/day. Under, the PPC (Scot) Reg. 2000, catering premises disposing of over 10 m^3/day, require a PPC discharge consent. Ironically, catering wastes from premises such as hospitals, educational canteens, etc which are not solely classed as catering premises, do not require any consent; their trade effluent is classed as 'foul sewage', which does not require to be not monitored.

CONCLUSIONS

Under NHSS food waste policy, up to 11,200 tonnes of food waste could be entering into the sewers each year, consuming up to 127,000 m^3 of clean water in the process, and producing 140,000 m^3 of trade effluents. Oils and grease contained in food increase the occurrence of sewer blockages at STW, which can interrupt normal treatment processes. During abnormal

periods, dated treatment works become overloaded; consequently unsatisfactory CSO's spill untreated sewage into the aquatic environment. Food waste can contain life-threatening pathogens. If these pathogens are released untreated into the water system it could increase the occurrence of pathogenic disease in humans and other species. FWD provide the fastest, cheapest and least regulated method of food waste disposal in the UK. The disposal of food wastes from hospitals into sewers should be regulated. The EU's recommendation to ban FWD should be implemented into UK Law.

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