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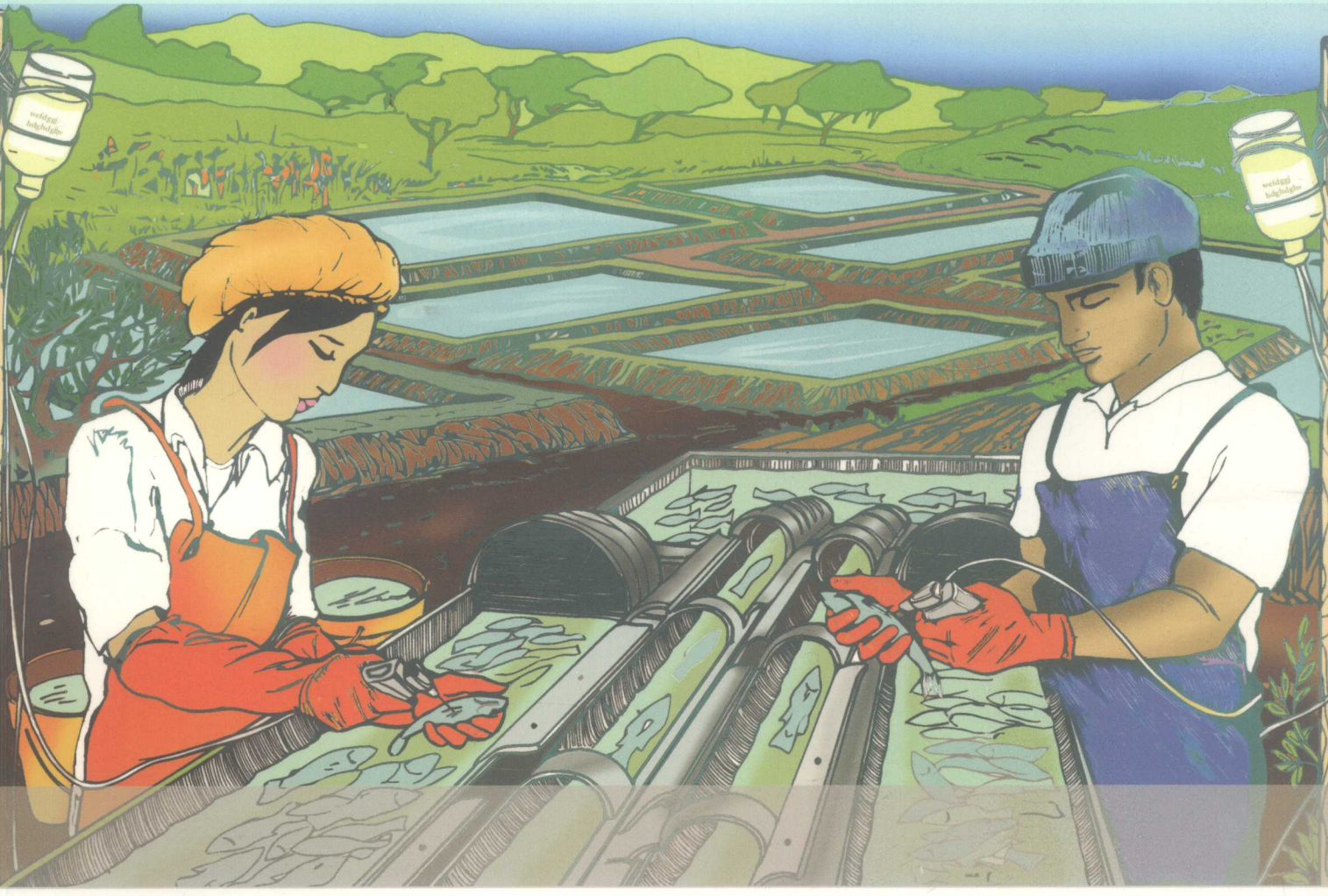

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Art work depicting fish vaccination by Ms Manuela D'Antoni, Marine and Inland Fisheries Service (FIRF), Department of Fisheries and Aquaculture, Rome, Italy

Preparation of this document

Under the Aquatic Animal Health and Aquatic Biosecurity Project, and building on a number of consultations that dealt with veterinary medicines,[1] the FAO/AAHRI Expert Workshop on Improving Biosecurity through Prudent and Responsible Use of Veterinary Medicines in Aquatic Food Production was convened in Bangkok, Thailand, from 15 to 18 December 2009, in order to understand the current status of the use of antimicrobials in aquaculture as a basis for improving biosecurity through responsible use of veterinary medicines in aquaculture production.

The project culminated in the publication of this document, which is presented in two parts. Part 1 contains 15 technical papers presented during the expert workshop and contributed by 29 specialists. Part 2 of this document contains the highlights of the expert workshop, which was participated by a total of 39 experts from some of the major aquaculture-producing countries, including experts from the Association of Southeast Asian Nations, the European Commission, the World Organisation for Animal Health and the World Health Organization, as well as experts from the private sector (producers, producer organization, and pharmaceutical and feed companies).

The expert workshop and publication, technically supervised by Dr Melba B. Reantaso, Aquaculture Officer, and Dr Rohana P. Subasinghe, Senior Aquaculture Officer, both from the Aquaculture Service, Fisheries and Aquaculture Resources Use and Conservation Division of the Food and Agriculture Organization of the United Nations (FAO) Fisheries and Aquaculture Department (FI), were made possible with financial assistance through the Programme Cooperation Agreement of Norway under B.1 and D.1 objectives administered through the FishCode Programme of FI and the Nutrition and Consumer Protection Division of the FAO Agriculture and Consumer Protection Department, respectively.

[1] Expert Meeting on the Use of Chemicals in Aquaculture in Asia (May 1996); GESAMP Ad-Hoc Meeting of the Joint Group of Experts on the Scientific Aspects of the Marine Environmental Protection Working Group on Environmental Impacts of Coastal Aquaculture (May 1996); Workshop on International Harmonization for Aquaculture Drugs and Biologics (February 1997); Workshop and Round Table of the European Association of Fish Pathologists (EAFP) (September 1997); World Health Organization (WHO) Consultation (with FAO and the World Organisation for Animal Health, OIE) on Global Principles for the Containment of Antimicrobial Resistance in Animals Intended for Food (June 2000); First Joint FAO/OIE/WHO Expert Workshop on Nonhuman Antimicrobial Usage and Antimicrobial Resistance: Scientific Assessment (December 2003); Joint FAO/WHO Technical Workshop on Residues of Veterinary Drugs without ADI/MRL (August 2004); and Joint FAO/OIE/WHO Expert Consultation on Antimicrobial Use in Aquaculture and Antimicrobial Resistance (June 2006).

Abstract

The current trend towards increasing intensification and diversification of global aquaculture has led to its dramatic growth, thus making aquaculture an important food-producing sector that provides an essential source of aquatic protein for a growing human population. For both developed and developing countries, the sector is recognized as creator of jobs and an important source of foreign export earnings. The expansion of commercial aquaculture, as is the case in commercial livestock and poultry production, has necessitated the routine use of veterinary medicines to prevent and treat disease outbreaks owing to pathogens, assure healthy stocks and maximize production. The expanded and occasionally irresponsible global movements of live aquatic animals have been accompanied by the transboundary spread of a wide variety of pathogens that have sometimes caused serious damage to aquatic food productivity and resulted in serious pathogens becoming endemic in culture systems and the natural aquatic environment. The use of appropriate antimicrobial treatments is one of the most effective management responses to emergencies associated with infectious disease epizootics. However, their inappropriate use can lead to problems related to increased frequency of bacterial resistance and the potential transfer of resistance genes in bacteria from the aquatic environment to other bacteria. Injudicious use of antimicrobials has also resulted in the occurrence of their residues in aquaculture products and, as a consequence, bans by importing countries and associated economic impacts, including market loss, have occurred. As disease emergencies can happen even in well-managed aquaculture operations, careful planning on the use of antimicrobials is essential in order to maximize their efficacy and minimize the selection pressure for increased frequencies of resistant variants. The prudent and responsible use of veterinary medicines is an essential component of successful commercial aquaculture production systems.

The FAO/AAHRI Expert Workshop on Improving Biosecurity through Prudent and Responsible Use of Veterinary Medicines in Aquatic Food Production was convened in Bangkok, Thailand, from 15 to 18 December 2009, in order to understand the current status of the use of antimicrobials in aquaculture and to discuss the concerns and impacts of their irresponsible use on human health, the aquatic environment and trade. Such discussions became the basis for drafting recommendations targeted for both government and private sectors and for developing guiding principles on the responsible use of antimicrobials in aquaculture to be considered as part of future FAO Code of Conduct for Responsible Fisheries (CCRF) Technical Guidelines on Prudent and Responsible Use of Veterinary Medicines in Aquaculture.

Because aquaculture is expected to continue to increase its contribution to the world's production of aquatic food, offer opportunities to alleviate poverty, increase employment and community development and reduce overexploitation of natural aquatic resources, appropriate guidance to aquaculture stakeholders on the responsible use of veterinary medicines has become essential. Safe and effective veterinary medicines need to be available for efficient aquaculture production, and their use should be in line with established principles on prudent use to safeguard public and animal health. The use of such medicines should be part of national and on-farm biosecurity plans and in accordance with an overall national policy for sustainable aquaculture.

This publication is presented in two parts: Part 1 contains 15 technical background papers presented during the expert workshop, contributed by 29 specialists, and which served as a basis for the expert workshop deliberations; Part 2 contains the highlights of the expert workshop.

Bondad-Reantaso, M.G., Arthur, J.R. & Subasinghe, R.P., eds. 2012.
Improving biosecurity through prudent and responsible use of veterinary medicines in aquatic food production.
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Preface

Modern aquaculture, through the intensification of culture systems and the diversification of both the species cultured and the culture methods employed, often creates an ideal environment for pathogens to flourish. The expanded and occasionally irresponsible global movements of live aquatic animals have been accompanied by the transboundary spread of a wide variety of disease agents that have sometimes caused serious damage to aquatic food productivity and resulted in serious pathogens becoming endemic in culture systems and the natural aquatic environment. Traditionally, the threats to aquaculture posed by aquatic pathogens have been addressed through the use of antimicrobials, including chemotherapeutants, disinfectants, antibiotics and vaccines. However, the inappropriate use of antimicrobials can lead to problems related to increased frequency of bacterial resistance, with negative impacts on the efficacy of these agents to control infectious diseases in aquaculture and the potential transfer of resistance genes in bacteria from the aquatic environment to other bacteria and the possibility of resistance extending to human pathogens. Injudicious use of antimicrobials has also resulted in the occurrence of their residues in aquaculture products, resulting in commodity bans by importing countries and associated economic impacts.

By themselves, antimicrobials cannot fully prevent losses due to disease. A holistic approach is required by modern aquaculture, and this can be achieved only through effective biosecurity programmes whereby pathogens are excluded from the culture environment. The Food and Agriculture Organization of the United Nations (FAO) is promoting a holistic approach to modern aquaculture through effective biosecurity actions taken at different levels ranging from more responsible international trade in aquatic organisms to better on-farm practices. The responsible use of antimicrobials is an important part of farm biosecurity, as this helps ensure that pathogen challenges are minimized, that the natural defence mechanisms of the cultured stocks are maximized, and that disease and mortality, including costs of containing, treating and/or eradicating diseases, are reduced. The injudicious and/or incorrect use of antimicrobials poses a great concern to successful and sustainable aquaculture. In order to develop appropriate strategies or guidelines that will enable the rational and prudent use of antimicrobials, particularly by small-scale aquaculturists, we need to assess the current situation with regard to the extent of their use and misuse, and to have a good general understanding of how these substances are being applied in aquaculture.

The FAO/AAHRI Expert Workshop on Improving Biosecurity through Prudent and Responsible Use of Veterinary Medicines in Aquatic Food Production was convened in Bangkok, Thailand, from 15 to 18 December 2009, in order to understand the current status of the use of antimicrobials in aquaculture and to discuss the concerns and impacts of their irresponsible use on human health, the aquatic environment and trade. Such discussions became the basis for drafting recommendations targeted for both government and private sectors and for developing guiding principles on the responsible use of antimicrobials in aquaculture to be considered as part of future FAO Technical Guidelines for Responsible Fisheries on Prudent and Responsible Use of Veterinary Medicines in Aquaculture.

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The editors would like to thank officials of the Fisheries and Aquaculture Department (FI) – J. Jia, I. Karunasagar and W. Miao for support, guidance and encouragement and E. Irde for the organization and conduct of the expert workshop and contribution to this publication. The kind assistance of T. Farmer, M. Guyonnet and M. Panzironi, also of FI, and S. Arthur (desktop publisher) for various types of assistance during the final production of this document is much appreciated.

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Abbreviations and acronyms

AAHP	aquatic animal health practitioner
AAHRI	Aquatic Animal Health Research Institute
ADI	acceptable daily intake
AHD	1-aminohydantoin
AMDUCA	Animal Medicinal Drug Use Clarification Act (United States of America)
AMOZ	3-amino-5-morpholinomethyl-1,3-oxazolidin
AMR	antimicrobial resistance
AMU	antimicrobial use
AO	Administrative Order (Philippines)
AOZ	3-amino-oxazolidinone
BAI	Bureau of Animal Industry (Philippines
BFAD	Bureau of Food and Drugs (Philippines)
BFAR	Bureau of Fisheries and Aquatic Resources (Philippines)
BKD	bacterial kidney disease
BMP	best management practice; better management practice
BW	body weight
CAC	Codex Alimentarius Commission
CCRVDF	Codex Committee on Residues of Veterinary Drugs in Foods
CEDMA	Centre for Environment and Disease Monitoring in Aquaculture (Viet Nam)
CLSI	Clinical and Laboratory Standards Institute
CNY	Chinese yuan
CoC	Conduct of Conduct for Responsible Aquaculture Farming
CO_{WT}	wild type cut-off value
DA	Department of Agriculture (the Philippines)
DAH	Department of Animal Health (Viet Nam)
DG SANCO	Directorate General for Health and Consumer Affairs
DOA	Department of Aquaculture (Viet Nam)
DOF	Department of Fisheries (Thailand)
DOH	Department of Health (the Philippines)
DOSTE	Department of Science, Technology and Environment (Viet Nam)
EMB	Emamectin benzoate
ELISA	enzyme-linked immunosorbent assay
EU	European Union
EUCAST	European Committee on Antimicrobial Susceptibility Testing
FAO	Food and Agriculture Organization of the United Nations
FDA	Food and Drug Administration (Thailand)
FDA-CVM	Food and Drug Administration's Center for Veterinary Medicine (United States of America)
FDA-DOH	Food and Drug Administration-Department of Health (Philippines)
FFDCA	Federal Food, Drug, and Cosmetic Act (United States of America)
FIQAS	Fish Inspection and Quality Assurance Service (Philippines)
FOO	Fisheries Office Order (the Philippines)
FSANZ	Food Standards Australia New Zealand
FVO	Food and Veterinary Office
GAqPs	good aquaculture practices
GFI	Guidance for Industry
GMO	General Memorandum Order (Philippines)
GMO	genetically modified organism

GMP	good management practice; good manufacture practice
HMP	health management programme
HACCP	Hazard Analysis and Critical Control Point
H_2O_2	hydrogen peroxide
IGO	intergovernmental organization
IPN	infectious pancreatic necrosis
ISA	infectious salmon anaemia
JECFA	Joint FAO/WHO Expert Committee on Food Additives
LCMSMS	liquid chromatography tandem mass spectrometry
LMG	luecomalachite green
MARD	Ministry of Agriculture and Rural Development (Viet Nam)
MIC	minimum inhibitory concentration
MOFI	Ministry of Fisheries (Viet Nam)
MRL	maximum residue level
MRL	maximum residue limit
MRPL	minimum required performance limit
NACA	Network of Aquaculture Centres in Asia and the Pacific
NARMS	National Antimicrobial Resistance Monitoring System (United States of America)
NGO	non-governmental organization
NOAEL	no-observed adverse effect level
NRI	normalized resistance interpretation
NWT	non-wild type
OIE	World Organisation for Animal Health
PD	pharmacodynamics
PHP	Philippine peso
PK	pharmacokinetics
ppb	parts per billion
ppm	parts per million
QC	quality control
RAHO	Regional Animal Health Office (Viet Nam)
RA	Republic Act (Philippines)
RIA 1	Research Institute for Aquaculture No. I (Viet Nam)
SAG	Agriculture and Livestock Service (Chile)
SEM	semicarbazide
SERNAPESCA	National Fisheries Service (Chile)
SFR	specific feeding ratio
SPF	specific pathogen free
SPIC	Single Plate Internal Control
SPS Agreement	Sanitary and Phytosanitary Agreement of the World Trade Organisation
SRS	salmon rickettsial syndrome
SUBPESCA	Undersecretariat of Fisheries (Chile)
USDA	United States Department of Agriculture
VHML	*V. harveyi* myovirus-like
VICH	International Cooperation on Harmonisation of Technical Requirements for Registration of Veterinary Medicinal Products
VNN	viral nervous necrosis
WHO	World Health Organization
WSSV	whitespot syndrome virus
WT	wild type
WTO	World Trade Organization

Contents

Public health and trade impact of antimicrobial use in aquaculture

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ABSTRACT

Detection of residues of certain banned antibiotics in fish and crustaceans in international trade during 2001–2002 led to greater attention on the public health risks owing to the use of antimicrobial agents in aquaculture. The risk of residues with respect to antimicrobials that are permitted for use in aquaculture is managed by enforcing a maximum residue limit (MRL), but there are very few antimicrobials for which MRLs have been established by international agencies. Most fish importing countries adopt a zero tolerance approach regarding residues of antimicrobials that are banned for use in food animals. In such cases, residue levels that attract regulatory action are based on analytical capability rather than toxicology of the residues. Development and spread of antibiotic resistance has been a cause of concern, although this issue is complicated by possible multiple origins of resistance traits found in aquatic bacteria. Work done in this area by international agencies such as the Food and Agriculture Organization of the United Nations, the World Organisation for Animal Health, the World Health Organization and the Codex Alimentarius Commission is reviewed in this paper.

INTRODUCTION

The importance of antimicrobial agents in protection of animal health has been widely acknowledged, but the negative impacts of the use of these agents in animals raised for food have been a cause of concern. The Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO) and the World Organisation for Animal Health (OIE) have organized several expert consultations and technical meetings to review the global situation and develop recommendations. While the issue of selection and spread of antibiotic-resistant bacteria in aquaculture has been deliberated upon for quite some time, the issue of antimicrobial residues in aquaculture products came to the fore in 2001 following marked improvements in laboratory methods to detect residues. This was followed by disruptions of trade in aquaculture products. According to the World Trade Organisation's Sanitary and Phytosanitary Agreement (SPS Agreement), countries have the right to establish measures to protect the life and health of their population and also to determine the level of protection that is appropriate for the country; however, available scientific evidence should be used when