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REVIEW

Rabbit production and science: the world and Italian scenarios from 1998 to 2018

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ABSTRACT

The present survey evaluates production, research funds and scientific activity relating to rabbits in Italy, Europe and all over the world during the last 20 years. Official statistics have several weaknesses for a small and diversified production like that of rabbits. Different methods for collecting and providing data in the different countries can be used and data for backyard production can miss. According to FAO, in 2017, China and the Democratic People's Republic of Korea contributed 73.3% to the global volume of rabbit meat. The two main EU producing countries, Spain and France, lost 12.2 and 6.4%, respectively, of their former share of world production compared to 1998. Whilst Italy is self-sufficient in rabbit meat production, trade exchanges are low, and meat consumption is decreasing. In regards to research funding, based on collected information which can be not fully comprehensive, China stands in the top position and Italy is placed fourth after France and Germany. Italy, France and Spain are among the top-five publishing countries and 'World Rabbit Science' is among the top publishing scientific journal in Agricultural and Biological Sciences (ABS). In the case of Veterinary Sciences, 'Veterinary Record' is one of the top journals. In Italy, ABS publications mainly focussed on Meat quality, Nutrition and feeding and Ethology and welfare. Pathology and hygiene and Breeding and genetics were the most published topics in Veterinary Science. The Universities of Napoli, Milano, Bari, Padova, Pisa, Perugia and Bologna provide teaching in rabbit science and production within their educational offer.

HIGHLIGHTS

- Italian funds for research in rabbit science are minimal and mainly provided by the Italian Ministry of Health;
- Italian researchers in rabbit science are very active in publications through peer-reviewed international scientific journals;
- Italian research activity is focussed on Meat quality, Nutrition and feeding, and to a lesser extent Breeding and genetics and Welfare and ethology.

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Production; meat consumption; research funding; publications; teaching

Introduction

Until the 1960s in Italy, rabbit breeding was a minor industry and mainly intended to meet the basic needs of rural families. After a strong development around the 1980s, rabbit breeding became intensive. This development was favoured by the excellent quality of rabbit meat, rich in protein and low in fat and cholesterol. Moreover, the Italian rabbit breeding industry was characterised, compared to the European industry, by high production efficiency expressed both in terms of efficient work productivity and feeding costs (Corrent 2001).

According to the Food and Agriculture Organisation of the United Nations (FAO), in 2017 Italy was the fifth-largest-producer of rabbit meat in the world following China, the Democratic People's Republic of Korea, Spain and Egypt (Food and Agriculture Organization of the United Nations [FAO] 2019). In Italy, rabbit production is the fourth largest meat production industry and ranks well behind beef, pork and

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poultry in terms of volume and importance. Italian production is estimated by Food and Agriculture Organization of the United Nations [FAO] (2019) to be 46,533 Tons Equivalent Carcases (TEC). However, the Italian National Institute of Statistics (Italian National Institute of Statistics [ISTAT] 2019) reported more reliable data accounting for 28,675 TEC with about 19 million slaughtered rabbits. Italy is almost self-sufficient in rabbit production and the small amount of trade is mainly intra-EU (Italian National Institute of Statistics [ISTAT] 2019). However, rabbit meat consumption has significantly decreased during the last few years due to several causes such as the negative effects of the economic crisis and the increasing consumer disaffection due to an increasing association with the perception of rabbits as pets and also to a progressive change in the lifestyle and eating habits of the consumer (Petracci et al. 2018b).

Public opinion also plays a relevant role in this scenario asking for the adoption of welfare-friendly rearing techniques for farmed animals including rabbits. Consumers who face a change in lifestyle and eating habits are more informed about what they eat (Dinu et al. 2010). Their commitments to environmental protection, animal welfare and health also impact on the perception of product quality (Petrescu and Petrescu-Mag 2003). A Slow Food survey on meat consumption and consumption habits as a function of the perception of animal welfare showed that consumers associate a healthy and balanced diet in animals with a healthy and high nutritional quality of their meat (Borra and Tarantola 2013). The increasing attention on animal welfare, also fed by the various animal rights campaigns, is reflected in meat consumption: 34% of European consumers and 30% of Italian consumers say they refuse meat for ethical reasons (Borra and Tarantola 2013).

In order to evaluate changes in the Italian rabbit sector over the last 20 years and to examine whether the sector can rely on solid scientific support, this article shows the evolution of production of rabbit meat, the research funding and outputs in rabbit science and, finally, the teaching activities of the Italian Universities addressing rabbit science.

Materials and methods

Production dynamic

Food and Agriculture Organisation of the United Nations food balance sheets were accessed to obtain data on rabbit meat production at global level (Food and Agriculture Organization of the United Nations [FAO] 2019) for the most recent year (2017). The most recent report by the European Union was also accessed (European Union [EU] 2017). Statistics on domestic production and trade markets were obtained from national agencies (Italian National Institute of Statistics [ISTAT] 2019) and producer associations such as the Italian Association of Producers of Animal Feedstuffs ([ASSALZOO] Italian Association of Producers of Animal Feedstuffs 2018).

Distribution of research funds

Data on the funds allocated for research were collected by ASIC (Italian Association of Rabbit Science) through the on-line forum of the World Rabbit Science Association (WRSA). Data were collected from different countries, i.e. China, France, Germany, Italy, Mexico and Spain, and classified according to different research topics: Multi-topics, Welfare and housing, Welfare and transport, Health, Nutrition and feeding, Genetics and Reproduction.

Scientific publications

Data concerning scientific publications on rabbit science were analysed by using Scopus, the on-line database of peer-reviewed literature by Elsevier (2019). A search was conducted using the word 'rabbit' in 'article title, abstract, keywords'. Then the search was restricted to the subject area 'Agricultural and Biological Sciences' by excluding all other areas for two periods, i.e. years 1998–2012 and years 2013–2018. Next, a second search with the same word was run first restricting to the subject 'Veterinary' and excluding the remaining subjects and second, using the same time intervals mentioned above. The top-ten countries and top-eight journals were identified for the two subjects. A third search was focussed on Italy, by limiting the results to Italy in 'Countries/Territory', and the top-five journals were listed. Then, major fields of research in rabbit science were identified based on the research sessions usually held at the World Rabbit Congresses, i.e. Breeding and genetics, Reproduction, Nutrition and feeding, Pathology and hygiene, Meat quality, Ethology and welfare, Fur and wool, Management and economics. Finally, a search was carried out by setting the word 'rabbit' and the words used for defining these research fields in 'article title, abstract, keywords'. The search was then restricted first to the subject area 'Agricultural and Biological Sciences' and then to the subject area

Table 1. The change of global rabbit meat production between 1998 and 2017 at Continent base (data × 1000 tons equivalent carcases, TEC; source: FAO, 2019).

	1998	2017	Change
Continent			
Africa	73	88	+21%
Americas	21	17	−19%
Asia	325	1,088	+235%
Europe	384	290	−25%
Oceania	–	–	–
World	803	1,483	+85%

'Veterinary' both at world and Italian level for the time period 1998–2018.

Academic courses

Italian University courses that teach rabbit breeding have been identified and divided by scientific areas and number of credits (ECTS). Due to the different number of hours of didactic teaching that form one credit in the various Italian Universities, the number of ECTS devoted to rabbit science was estimated taking into consideration the content of the courses.

Results and discussion

Production

Official statistics have several weaknesses especially in the case of a small and diversified production such as that of rabbits which are produced using different systems, i.e. commercial intensive farms and backyard/rural conditions (Lebas and Colin 1992). Different reasons can account for discrepancies in available data, e.g. different methods for collecting and providing data in the different countries or missing data for backyard production. Nevertheless, FAO estimates of rabbit production are the starting point for any evaluation at a world level, despite data are missing for some countries or appear overestimated for other ones.

Global rabbit meat production is currently estimated at 1,482,441 TEC corresponding to 971,951 million slaughtered animals (Table 1). Between 1998 and 2017, the global production volume of rabbit meat increased by 680,000 TEC (+85%). However, a closer look at the continent level revealed that Asia is by far the leading production area in the world and rabbit production has increased only in Asia (+763,000 TEC) and Africa (+15,000 TEC), whereas there has been a remarkable decline in both Europe (−94,000 TEC) and the Americas (−4,000 TEC). Rabbit meat is not produced in most countries of the Near East and Oceania. The changing contribution of the continents to global rabbit meat production for the analysed period is shown in Figure 1, where the substantial increase of contribution by Asia is shown while Europe lost 28 percentage units of its former production.

A comparison of the ranking of the ten-leading countries in rabbit production in 1998 and 2017 demonstrates the leading role of China and the Democratic People's Republic of Korea (Table 2). These two countries contributed 73.3% to the global volume in 2017. On the other hand, the main two EU producing countries, Spain and France, lost 12.2 and 6.4 percentage units of their former share. It is also worth mentioning that Hungary lost its leading position occupied in 1998 to the Russian Federation.

Within EU, there are around 180 million rabbits reared for meat consumption. Approximately 119 million (66%) are kept in commercial farms and slaughtered in approved slaughterhouses. An additional 61 million (34%) are farmed, sold and consumed via backyard farms, direct and local sales (European Union [EU] 2017). Rabbit farming is highly concentrated in three countries representing 83% of the total EU production. Spain is the main producer with 57,000 TEC in 2017, followed by Italy, with 47,000 TEC, and France with 44,000 TEC (Food and Agriculture Organization of the United Nations [FAO] 2019).

To evaluate Italian rabbit meat production, data were taken from both FAO and ISTAT reports. If data for the early 2000's is correct, during the last 10 years there is a discrepancy between production trends reported by the two Institutions: a progressive decrease was recorded by ISTAT, while FAO estimated a growth until 2014 followed by a decrease only in the last few years (Figure 2). The trend recorded by ISTAT agrees with data available from ASSALZOO which estimates that Italian production of compound feeds for rabbits decreased by 33% from 2007 to 2017 (ASSALZOO 2018). In a recent report by the European Union [EU] (2017), it is estimated that 84% of Italian production is derived from animals kept in commercial farms and slaughtered for human consumption in approved slaughterhouses, while the remaining is produced from rabbits reared, sold and consumed via backyard farms, direct and local sales. In addition, there is a lack of national breeding companies and most breeder rabbits are imported from France (i.e. Grimaud, Hyla, Hycole). Due to changes in consumer perception toward animal welfare and the need to reduce antibiotic use, in Italy there is a strong demand for the adoption of animal welfare-friendly housing systems, with the substitution of the small bicellular cages in favour of larger cages or alternative elevated

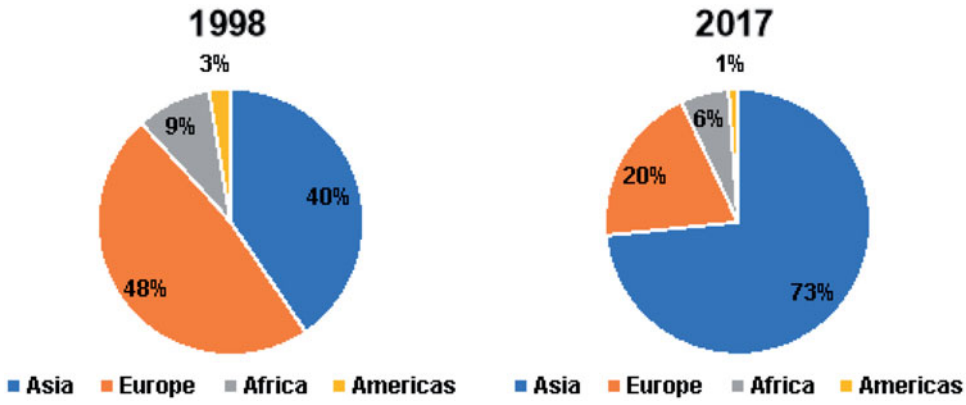

Figure 1. The contribution of the continents to world rabbit meat production between 1998 and 2017 (source FAO 2019).

Table 2. The ten-leading rabbit-meat-producing Countries in 1998 and 2017 (×1000 tons equivalent carcases, TEC; source: FAO 2019).

1998			2017		
Countries	Production	Share (%)	Countries	Production	Share (%)
China	308	38.4	China	932	62.9
Spain	129	16.1	Democratic People's Republic of Korea	154	10.4
France	76	9.4	Spain	57	3.9
Egypt	54	6.7	Egypt	56	3.8
Germany	41	5.1	Italy	47	3.1
Italy	41	5.1	France	44	3.0
Czech Republic	38	4.8	Germany	42	2.9
Ukraine	14	1.7	Czech Republic	39	2.7
Democratic People's Republic of Korea	13	1.6	Russian Federation	19	1.3
Hungary	9	1.2	Ukraine	12	0.8
First 10 Countries	723	90.1	First 10 Countries	1403	94.6
World	803	100.0	World	1482	100.0

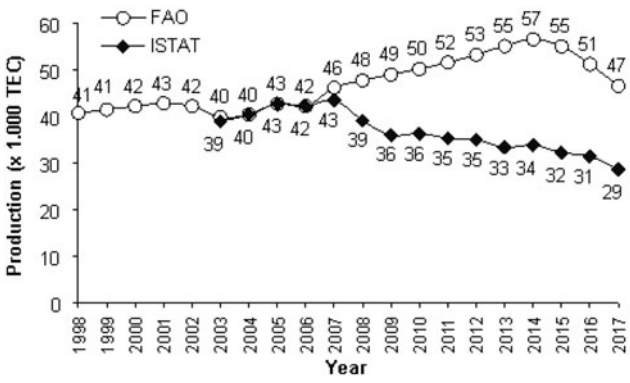

Figure 2. Italian production of rabbit meat (× 1000 tons equivalent carcases, TEC) during the last 20 years (sources: FAO database, 2019; ISTAT 2019).

pens, also called parks, and the overall improvement of farm management for increasing the health of farmed rabbits (Trocino et al. 2014, 2015; Di Martino et al. 2019). These alternative park systems have been already adopted in some countries like Belgium, Germany and The Netherlands, that are small producers of rabbits, without remarkably negative effects on production performance at fattening levels (Maertens and Buijs 2016). Nevertheless, the use of pens/parks for breeding does is still at the developmental stage and it is frequently associated with aggression among does and decreased animal welfare in case of collective housing (Rommers and De Greef 2018; Zomeño et al. 2018; Dal Bosco et al. 2019; Szendrő et al. 2019).

At present, Italy remains nearly self-sufficient and trade exchanges are very limited (Table 3). The main import partners are France, Spain and Hungary, whereas Germany and Malta are the biggest export markets for Italy. Even if the consumption of rabbit meat is traditional in Italy as in other Mediterranean countries, it has progressively reducing since 2010. Overall, high price, improper presentation (i.e. head still on carcase) and lack of processed products available on the market (compared especially with poultry meats), together with increasing cultural factors (i.e. pet status, concerns about the welfare of caged animals) are progressively reducing the appeal of rabbit meat (Petracci et al. 2018b). Recently, following an initiative of the Animal Science and Production Association (ASPA), a method to estimate real per-capita consumption of rabbit meat has been established by using a conversion factor from carcase to edible meat (excluding offal, dissectible fats and bones) and estimated losses at retailing and home-consumption.

Table 3. Italian rabbit production and market from 2003 to 2017 (source: ISTAT 2019).

	2003	2010	2017
Production (× 1000 TEC[a])	38.9	36.3	28.7
Import (× 1000 TEC[a])	7.1	7.4	5.1
Export (× 1000 TEC[a])	6.7	2.7	2.6
Amount available for consumption (× 1000 TEC[a])	39.3	41.0	31.2
Self-sufficiency (%)	99.0	88.5	92.0
Apparent meat consumption (kg per-capita)	0.69	0.68	0.52
Real meat consumption (kg per-capita)[b]	0.37	0.37	0.28

[a]TEC: Tons Equivalent Carcases.
[b]Calculated on the basis of the conversion factor proposed by Petracci et al. (2018a).

Based on this method, current per-capita rabbit meat consumption is estimated at around 0.28 kg/year (Petracci et al. 2018a) (Table 3).

Distribution of research funds

In regards to the allocation of research funds for rabbit research, information can be not complete because data were obtained through the on-line forum of the WRSA and answers were on a voluntary basis. Nevertheless, based on collected information, China has the highest with 2443 k€ allocated over 3 years, intended for various topics. In Europe, Italy is placed fourth, after Germany, Spain and France, thanks to funds allocated by the Istituto Zooprofilattico Sperimentale delle Venezie (IZSVe) and the Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna (IZSLER).

The main topics for which these funds are intended are welfare and health (Table 4). The distribution of funds and the quantity compared to the various topics are shown in Figures 3 and 4.

Scientific publications

In this survey, Scopus was used to analyse scientific publications on rabbit science based on indexed journals and books. This choice restricted the number of selected documents in quantity and in quality, and avoided an over estimations of the scientific production. As regards quantity, several items were not included, e.g. papers at scientific congresses, which usually communicates partial and preliminary results before the submission of the full paper to a scientific journal. As regards quality, all indexed papers are usually submitted to a peer-review evaluation which is not necessarily for other types of publications.

For the subject area 'Agricultural and Biological Sciences', the total number of publications from all over the world was 2068 in the years 1998–2012 and 1165 in the years 2013–2018 (Table 5). This means that the number of publications for the last 6 years accounted for 56% of the publications produced in the previous 15 years. Indeed, the publication policies and publishing activities of researchers in the two time intervals were very different due to the increasing weight of scientific production, mainly referenced papers, on the selection procedures of professors and researchers in recent times. In the last 6 years, the publication rates have increased at a world level from 138 to 194 publications per year in the subject 'Agricultural and Biological Sciences'.

Italy, France and Spain (top meat producers in EU) are among the top-five publishing countries in both periods for the 'Agricultural and Biological Sciences' (Table 5), which is not the case for the 'Veterinary' area (Table 6). From the first to the second period only two out of the top-ten producing countries changed: Japan and India have exited the top-ten list whereas Hungary and Egypt have entered it (Table 5). As far as scientific journals are considered, 'World Rabbit Science' is the top publisher of the subject for both periods, but several other journals addressing livestock production have published research in rabbit science. In the latest time period, a new journal, i.e. 'Journal of the American Association for Laboratory Animal Science', appears in the list of the top publishing scientific journals. Among other reasons, this result may be ascribed to the increased interest in the welfare of laboratory rabbits.

In the case of the subject 'Veterinary', the total number of publications was 2378 in the years 1998–2012 and 1114 in the years 2013–2018 (Table 6), with publications in the last six years accounting for 47% of the publications in the previous 15 years, with 159 and 186 papers per year in the two time periods, respectively. Comparing both intervals, the list of the top-ten countries in publication activity has changed with the exit of Japan and Hungary and the entrance of Italy and Spain (Table 6), with 'Veterinary Record' being one of the top journals for publishing rabbit research.

The above described results at world level are consistent with data reported by Lebas and Colin (1992) who recorded 463 publications on rabbits referred to the years 1990 and 1991 in three reviews of abstracts by CAB International, with 51% of publications from five countries, i.e. USA, Italy, Spain, Germany and France.

In the case of Italy, the total number of publications in the subject 'Agricultural and Biological Sciences' was 189 in the years 1998–2012 and 106 in the years 2013–2018 (Table 7). With regards to 'Veterinary', the

Table 4. World distribution of research funding for rabbit science.

Country	Institution	Topic	Period	Budget, k€
China	China Agricultural University	Multi-topic	2017–2020	2443
France	INRA	Nutrition	2016–2019	70
France	INRA GenPHySE	Welfare and management	2018–2021	534
Germany	University	Welfare and management	3 years	93
Germany	University	Welfare and management	3 years	600
Italy	IZSVe	Welfare and health	2 years	60
Italy	IZSVe	Welfare and health	2018–2019	116
Italy	IZSLER	Health	2014–2017	58
Italy	IZSLER	Health	2015–2018	100
Italy	IZSLER	Health	2017–2019	67
Italy	IZSLER	Health	2017–2019	75
Italy	IZSLER	Welfare and management	2017–2019	89
Mexico	University of Tabasco	Nutrition	2018	10
Spain	University	Nutrition and health	2016–2019	212
Spain	University	Reproduction	2016–2018	113
Spain	University	Genetics	2017–2019	182
Spain	University	Health and management	2018–2019	115

IZSVe: Istituto Zooprofilattico Sperimentale delle Venezie; IZSLER: Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna.

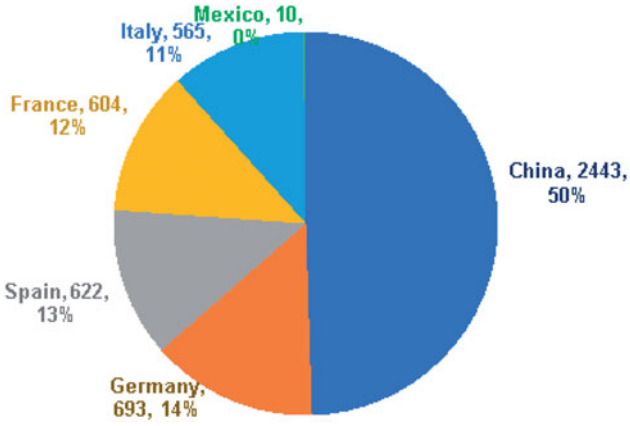

Figure 3. World distribution of research funding (k€, % of the total) for rabbit science by country (years 2016–2020).

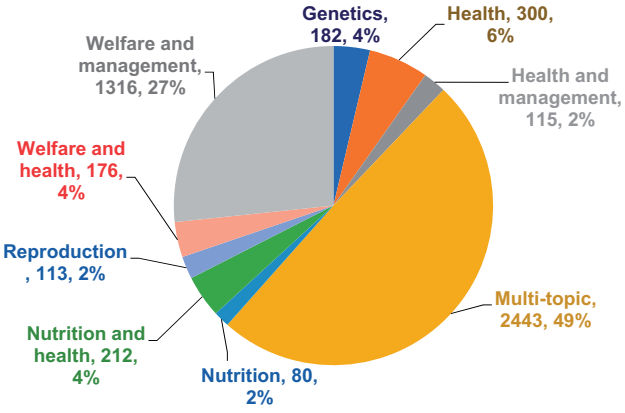

Figure 4. World distribution of research funding (k€, % of the total) for rabbit science by topic (years 2016–2020).

total number of publications was 55 in the years 1998–2012 and 67 in the years 2013–2018 (Table 7). From the first to the second period, the publication activity increased from 12.6 to 17.7 papers per year in the former subject and from 3.7 to 11.2 papers per year in the latter one.

Table 8 shows the distribution of publications in rabbit science according to the research fields usually considered for the organisation of sessions in the World Rabbit Congresses. The data in the table refer to world and Italy in the interval 1998–2018. The lower number of total publications scored in the two subject areas both at world and Italian level from Tables 5 and 6 to Table 8 implies that the words used for the search in Table 8 (referring to the research fields in rabbit science) were not fully comprehensive. Nevertheless, data in Table 8 allowed a general characterisation of the world and Italian publication activity in rabbit science.

With regards to 'Agricultural and Biological Sciences' at a world level, the majority of publications were published in the field of Nutrition and feeding (31.9% of the total), followed by Breeding and genetics (27.2%). Publications in Reproduction and Meat quality stood at 13.2% and 11.6% of the total publications in the subject area, whereas those in Pathology and hygiene, Ethology and welfare, and Fur and wool represented around 4–6% each. Finally, the lowest percentage of publication (1.1%) was in the Management and economics field. As expected, publications in the subject area 'Veterinary' were mainly in Pathology and hygiene (37.1% of the total) followed by Breeding and genetics (26.5%) and Nutrition and feeding (16.5%). The other research fields, publications in Ethology and welfare, represented 8.7% of the total Veterinary publications, whereas the percentage of publications in the other research fields was always lower than 5%.

Despite comparison with the present survey is difficult because of differences in literature sources and

Table 5. Number of publications at a world level: results of the search in Scopus for 'rabbit' in the subject area 'Agricultural and Biological Sciences' excluding all other subject areas (accessed 16 June 2019).

Period	1998–2012	Period	2013–2018
Years	15	Years	6
Total publications	2068	Total publications	1165
Publications per year	138	Publications per year	194
Top 10 Countries (publications per year)		Top 10 Countries (publications per year)	
USA	17.40	China	29.50
Spain	16.93	Spain	25.50
Italy	12.60	USA	19.83
France	11.27	Italy	17.67
Japan	8.47	France	13.00
China	7.60	Egypt	10.83
Australia	7.20	Brazil	9.67
United Kingdom	6.33	Australia	9.00
Brazil	6.00	United Kingdom	8.17
India	5.47	Hungary	6.67
Top eight journals (publications per year)		Top eight journals (publications per year)	
World Rabbit Science	12.47	World Rabbit Science	31.83
Livestock Research for Rural development	5.47	Animal	9.17
Meat Science	5.00	Meat Science	8.67
Italian Journal of Animal Science	4.47	Livestock Research for Rural Development	7.67
Asia Australasian Journal of Animal science	4.00	Modern Food Science and Technology	3.83
Animal	2.67	Journal of American Association for Laboratory Animal Science	3.67
Animal Science	2.67	Animal Feed Science and Technology	3.50
Animal Feed Science and Technology	2.60	Journal of Animal and Plant Science	3.50

Table 6. Number of publications at a world level: results of the search on Scopus for 'rabbit' in the subject area 'Veterinary' excluding all other subject areas (accessed 16 June 2019).

Period	1998–2012	Period	2013–2018
Years	15	Years	6
Total publications	2378	Total publications	1114
Publications per year	159	Publications per year	186
Top 10 countries (publications per year)		Top 10 countries (publications per year)	
USA	24.27	USA	27.83
India	13.87	Brazil	19.17
United Kingdom	11.07	United Kingdom	15.83
Turkey	10.80	Italy	11.17
Germany	10.27	India	11.00
Poland	10.27	Poland	9.17
Brazil	8.80	Germany	9.00
Japan	8.80	Turkey	7.83
France	6.00	France	7.67
Hungary	4.80	Spain	6.83
Top eight journals (publications per year)		Top eight journals (publications per year)	
Indian Veterinary Journal	11.60	Veterinary Record	12.67
Veterinary Record	9.87	Journal of Exotic Pet Medicine	8.17
Journal of Veterinary Medical Science	6.80	Arquivo Brasileiro de Medicina veterinaria E Zootecnica	6.33
Medycina Weterynaryjna	4.93	Journal of Veterinary Medical Science	5.67
American Journal of Veterinary Research	4.80	Veterinary Clinics of North America Exotic Animal Practice	5.67
Veterinary Research Communication	4.27	Research in Veterinary Science	5.50
Bulletin of the Veterinary Institute in Pulawy	4.20	BMC Veterinary Research	5.33
Arquivo Brasileiro de Medicina veterinaria e Zootecnica	3.87	Pesquisa Veterinaria Brasileira	5.33

data grouping, also Lebas and Colin (1992) reported that most studies in rabbit science published at world level during 1990 and 1991 dealt with Nutrition (36.2% of the total). Then, research activity covered Pathology (25.9% of the total publications), Reproduction (12.1%), Genetics (11.0%), Management (9.5%) and, lastly, Meat quality (4.3%).

In Italy, in the subject Agricultural and Biological Sciences, publications mainly focussed on meat quality (34.6% of the Italian publications in the subject area) followed by Nutrition and feeding (24.7%) and Ethology and welfare (13.2%). When the Italian scientific production is compared to the world production within every research field, Italian publications gave a larger contribution to Meat quality (38.4% of the world publications), followed by Management and economics (31.3%) and Ethology and welfare (27.3%). It is worth mentioning that in numerical terms, publications in Management and economics are very low (16 in the world and 5 in Italy).

In terms of the subject Veterinary, publications mainly focussed on Pathology and hygiene (36.1% of the Italian publications in the subject area) followed by Breeding and genetics (30.6%). Nutrition and

Table 7. Number of publications at an Italian level: results of the search on Scopus for 'rabbit' limiting to Italy as Country/Territory (accessed 16 June 2019).

Period	1998–2012	Period	2013–2018
Subject area: Agricultural and Biological Sciences		Subject area: Agricultural and Biological Sciences	
Years	15	Years	6
Total publications	189	Total publications	106
Publications per year (no.)	12.6	Publications per year (no.)	17.7
Italian Journal of Animal Science	59	World Rabbit Science	31
World Rabbit Science	38	Meat Science	25
Meat science	19	Animal	11
Animal	7	Italian Journal of Animal Science	9
Asia Australasian Journal of Animal science	7	Animal Feed Science and Technology	4
Subject area: veterinary		Subject area: veterinary	
Years	15	Years	6
Total publications	55	Total publications	67
Publications per year	3.7	Publications per year	11.2
Veterinary Research Communications	14	Journal of Exotic Pet Medicine	8
Journal of Exotic Pet Medicine	6	Veterinary Record	6
Journal of Veterinary Diagnostic Investigation	4	Research in Veterinary Science	5
Research in Veterinary Science	4	Veterinaria Italiana	5
Journal of Veterinary Medicine Series	3	Large Animal Reviews	4

Table 8. Number of publications at a world and an Italian level: results of the search on Scopus for 'rabbit' and the words defining the main research fields in rabbit science for the subject areas 'Agricultural and Biological Sciences' (ABS) and 'Veterinary' (VET) from 1998 to 2018 (accessed 16 June 2019).

	Period 1998–2018					
	World		Italy			
	ABS	VET	ABS		VET	
Research fields	No.[a] (%[b])	No.[a] (%[b])	No.[a] (%[b])	% world publications	No.[a] (%[b])	% world publications
Nutrition and feeding	450 (31.9)	149 (16.5)	45 (24.7)	10.0	4 (11.1)	2.7
Breeding and genetics	383 (27.2)	240 (26.5)	20 (11.0)	5.2	11 (30.6)	4.6
Reproduction	186 (13.2)	43 (4.8)	19 (10.4)	10.2	2 (5.6)	4.7
Meat quality	164 (11.6)	13 (1.4)	63 (34.6)	38.4	2 (5.6)	15.4
Pathology and hygiene	60 (4.3)	336 (37.1)	6 (3.3)	10.0	13 (36.1)	3.9
Ethology and welfare	88 (6.2)	79 (8.7)	24 (13.2)	27.3	4 (11.1)	5.1
Fur and wool	62 (4.4)	38 (4.2)	0	–	0	–
Management and economics	16 (1.1)	7 (0.8)	5 (2.7)	31.3	0	–
Total publications per subject area	1409	905	182		36	

[a]Number of publications.
[b]% in the subject area.

feeding and Ethology and welfare both comprised 11.1% of the Italian publications, whereas the contribution to Reproduction and Meat quality was negligible.

To compare the present results with the data from the period 1989–1993, presented by Castellini and Dal Bosco (1995), the Italian publications of the two subject areas (Agricultural and Biological Sciences; Veterinary) have been summed. Accordingly, 22.5% of the Italian publications in the period 1999–2018 were in the Nutrition and feeding field, 14.2% in Breeding and genetics, 9.63% in Reproduction, 29.8% in Meat quality, 8.72% in Pathology, 12.8% in Welfare and Ethology; 2.29% in Management and Economics (data not reported in tables). Thus, the comparison between 1989–1993 and 1999–2018 showed that the Italian publications in Nutrition and feeding slightly increased their rate on the total (17–22.5%) whereas the publications in Meat quality greatly increased (from 11 to 29.8%); those in Reproduction maintained their weight (12 versus 9.63%); and those in Welfare and Ethology gained a position (12.8% of the total) which was completely absent in the previous survey; lastly, publications in the Pathology field greatly decreased from 31 to 8.72% of the total. The high Italian share in Meat quality is explained by the publication activity of some research groups specifically devoted to this topic. In Italy, publications in Welfare and Ethology have been promoted by the increasing attention of consumers towards animal welfare and by the industry need of developing alternative systems. On the other hand, the reduction of the Italian contribution in the Pathology field has to be attributed to the decreased number of researchers and funds both from the Italian Health Authority and Research Organisations for Animal Health and Food Safety and from the Universities.

The comparison of the present survey with the previous one for the Italian scientific production in the

Table 9. University courses and credits offered in Italy.

University	Department/School	Course type[a]	ECTS[b]	%
Bari	Veterinary Medicine	B	3	3.03
	Veterinary Medicine	B	3	3.03
	Veterinary Medicine	V	2	2.02
	Veterinary Medicine	S	3	3.03
Bologna	School of Agricultural Sciences and Veterinary Medicine	B	2	2.02
	School of Agricultural Sciences and Veterinary Medicine	M	4	4.04
	Veterinary Medicine	V	1	1.01
Camerino	Veterinary Medicine	V	4	4.04
Milano	Veterinary Medicine	B	1.5	1.52
	Agricultural and Food Sciences	M	2	2.02
	Veterinary Medicine	V	4	4.04
	Veterinary Medicine	V	2	2.02
	Veterinary Medicine	S	2	2.02
Molise	Environment, Agriculture and Food	B	2	2.02
Napoli	Agricultural Sciences	B	2	2.02
	Veterinary Medicine and Animal Production	B	2	2.02
	Veterinary Medicine and Animal Production	V	3	3.03
	Veterinary Medicine and Animal Production	V	4	4.04
	Veterinary Medicine and Animal Production	S	1	1.01
	Veterinary Medicine and Animal Production	S	2	2.02
	Veterinary Medicine and Animal Production	S	2	2.02
	Veterinary Medicine and Animal Production	S	2	2.02
Padova	Department of Agronomy Food Natural resources Animals and Environment	B	3	3.03
	Department of Agronomy Food Natural resources Animals and Environment	M	3	3.03
	Department of Animal Medicine, Production and Health	V	4	4.04
Palermo	Agricultural, Food and Forest Sciences	B	2	2.02
Perugia	Veterinary Medicine	B	3	3.03
	Agricultural Food and Environmental Sciences	M	4	4.04
Piacenza	Agricultural Food and Environmental Sciences	M	1.5	1.52
Pisa	Veterinary Sciences	B	4	4.04
	Veterinary Sciences	B	4	4.04
Sassari	Agricultural Sciences	B	1	1.01
	Veterinary Medicine	V	3	3.03
Teramo	Veterinary Medicine	B	3	3.03
	Veterinary Medicine	V	1	1.01
Torino	Agricultural Forest and Food Sciences	M	3	3.03
	Veterinary Sciences	V	3	3.03
Udine	Agricultural Science Environmental Science Animal Health and Breeding	B	3	3.03

[a]European Credit Transfer and Accumulation System.
[b]B: 3-year Bachelor Degree; M: 2-year Master Degree; V: 5-year Veterinary degree; S: post-degree specialising courses.

years 1989–1993 is not easy as the terms of reference are different. In fact, Castellini and Dal Bosco (1995) classified the total number of publications produced by the Italian Universities and the Italian Health Authority and Research Organisations for Animal Health and Food Safety and scored a total number of 379 items (i.e. 75.8 per year), including full papers published in refereed journals, contributions to International and National Congresses as well as publications on technical journals. Out of this total, 56% of contributions consisted of full papers published in refereed journals and contributions to international congresses that is a total of 212 items (i.e. 42.4 items per year). Based on the results of our survey, we could expect that the split between full papers and contributions to International Congresses was completely shifted towards congresses in the early time period, whereas during the last few years an opposite trend has been recorded. In fact, the sum of the yearly production in the two subject areas identified in our survey shows that the number of papers recorded in Scopus increased from 16.3 items per year in the period 1998–2012 to 28.9 items per year in the last 6 years (2013–2018). In other words, the scientific production of Italian researchers in rabbit science has not reasonably decreased in the last years, whereas it is increasingly recognised at an International level by means of increased publication in peer-reviewed scientific journals.

On the other hand, in the present survey, we were not able to record the number of Universities and Research centres performing research nor the number of Italian researchers publishing in rabbit science, whereas Castellini and dal Bosco (1995) had recorded 32 Institutions and 66.5 researchers in the 1989–1995 period.

University courses on rabbit science

The University that dedicates the largest number of teaching activities to rabbit science is Napoli (18% of the total), followed by Milano (12%), Bari (11%) and

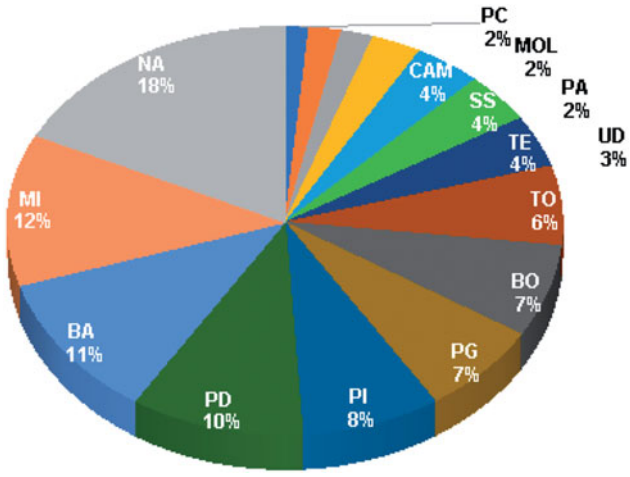

Figure 5. Distribution of teaching activity (% of total ETCS held in Italian Universities) on rabbit science and production. BA: Bari; BO: Bologna; CAM: Camerino; MOL: Molise; MI: Milano; NA: Napoli; PA: Palermo; PC: Piacenza; PD: Padova; PI: Pisa; PG: Perugia; SS: Sassari; TO: Torino; TE: Teramo; UD: Udine.

Padova (10%) (Table 9; Figure 5). Other Italian Universities that dedicate a number of hours of teaching to rabbit science and production are Bologna, Camerino, Perugia and Pisa, with four ETCS, mainly provided within the Veterinary Medicine Department. The greatest number of ETCS is provided inside the 3-year standard degrees (Table 9).

The Universities of Bari, Bologna, Milano, Napoli, Padova, Sassari, Teramo and Torino also have specialising modules after the 5-year Veterinary Medicine course.

In regards to University courses, in the Agricultural Science faculties most of the teaching activity is held during the 3-year Bachelor degrees and concerns rabbit housing and management. Veterinary faculties dedicate teaching mainly to rabbit pathology and physiology, both in the framework of 5-year Veterinary Medicine and post-degree specialising courses.

To sum up, Italian Universities give a fair amount of importance to teaching rabbit science and production, although rabbits are not among the major species, so it is fundamental to continue to give support to this sector and to maintain the actual level of education, production and competitiveness.

Conclusions

Despite the reliability and completeness of data related to a small production such as that of rabbits have some weakness, the current scenario of rabbit production and science in Italy can be represented as follows:

- the consumption of rabbit meat is progressively reducing; high price, improper presentation and lack of processed products, together with socio-economic factors are progressively reducing the appeal of rabbit meat;
- the National funds for research in rabbit science are scarce and mainly provided by the Italian Ministry of Health;
- the scientific production of Italian researchers in rabbit science is still very active and widely spread through peer-reviewed international scientific journals;
- the Italian research activity is focussed on Meat quality, Nutrition and feeding, and to a lower extent Breeding and genetics and Welfare and ethology.

In future, a greater effort of the rabbit production chain is required to join researchers and stakeholders to overcome critical issues and assure a stable (even if low) position in the animal production scenarios.

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