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Feral pharmaceuticalization—Biomedical uses of animal life in light of the global donkey hide trade

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Abstract

Medical and pharmaceutical uses of animal life have gone through vast changes in the past centuries. Although the commodification of animals and animal parts is by no means an invention of modernity, its procedures and practices have evolved in multiple ways across time. Most notably, the exploitation of non-human animal life has been increasingly segmented, industrialized, and globalized. The collateral expansion of scientific and market institutions has led to specific modes of rationalization of animal breeding, culture, and trade for pharmaceutical purposes. However, this rationalization process has never been immune to its own matter—and the materiality of non-human commodification processes irrigates seemingly ordered and layered practices. Based upon a study on the international trade of donkey hide, this paper offers a characterization of the current pharmaceutical uses of animal life through a series of epistemic and environmental tensions expressing frictions between the market's absorptive logic and non-human modes of existence. We describe this set of tensions as 'feral pharmaceuticalization' and contend that they offer new perspectives on the analysis of the contemporary pharmaceuticalization process. In addition, such tensions showcase the importance of investigating the expansion of technological markets not only as simultaneous knowledge and *milieux* (or bodies) making, or as simple science and market hegemonic processes, but also as the construction of new stages of conflict.

Keywords Biomedicalization · Traditional chinese medicine · Human-animal relations · Commodification · Animal use

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Introduction

> In a remote village in Narok, water scarcity is as old as the community's culture. But as long as the rural folk have beasts of burden to haul water to their homes, the scarcity isn't as tragic. At dawn, women and children would guide their donkeys to the nearest watering hole and drive them back home comfortably as the animals lugged the water cans. Then, about two years ago, donkey theft crept in and became rampant, robbing the village of its convenient means of transporting water and other goods. And now, women and children must carry water by themselves as they trek miles under the scorching sun to deliver the commodity home (Obi, 2019b).

Donkey theft has spread widely across several parts of Kenya, particularly in remote areas, leading to a sharp drop in the country's population of donkeys, according to the article quoted from *the* Nation (Obi, 2019b). The reason would be the burgeoning market for donkey hides in China, where a traditional medicine called ejiao (*Colla corii asini)* is made from gelatin extracted from boiled donkey hides. "Ejiao was in the past prescribed primarily to supplement lost blood but, today, it is sought for a myriad of uses, ranging from delaying ageing and increasing libido to treating side effects of chemotherapy and preventing infertility, miscarriage and menstrual irregularity" (Obi, 2019b).

Such a phenomenon, however, is not restricted to remote Kenyan areas. Contrarily, it can be observed in several other African and Latin American countries as well (Gameiro et al. 2021a, b; Binda 2019; Maigari 2020; Matlhola and Chen 2020; Chiwome 2019). Donkeys have been sourced from these continents as the Chinese donkey population strongly decreased (FAO 2021) and the skin prices increased, following a rise in ejiao production and prices. Behind these market movements, a key role has been played by the industrialization and the high scale production of ejiao—or its pharmaceuticalization. The product is praised for its medicinal and health properties by a growing Chinese urban population experimenting household income increase since the 1990s (Li 2016; The Donkey Sanctuary 2017). Besides economic prosperity, an increasing range of animal parts and tissues became common in Chinese medicine from the late 1950s onward, habituating the population "to using more of it, more often, and for more reasons than ever before" (Chee 2021), in consonance with a higher degree of consumption desire and pharmaceutical industrial production.

Before the popularization of donkey hide products a few decades ago, the access to and the consumption of ejiao had remained limited to China's highest elite. Now, the immediate impact of this larger demand on local communities and on environments where donkeys are sourced raise questions on the sustainability of this activity. The legal and illegal skin trade is said to put global donkey populations at risk and to represent an animal welfare catastrophe, mainly during transport and slaughter processes (Skippen et al. 2021; Tatemoto et al. 2021). Donkey breeding farms are scarce (or even non-existent in most regions), thus donkey reproduction and raising do not happen at an industrial scale, neither in Africa nor in Latin America.

Procuring donkeys in these uneven multispecies sites threatens the livelihoods of vulnerable communities, since donkeys are a source of income for an estimated 600 million people in low and middle-income countries, providing transport of goods and people, access to water for households and other livestock (Skippen et al. 2021). Within the donkey skin trade, market players are dispersed and often act individually in South–South trade chains composed of small to average-sized firms formally or informally established in supplying regions, where itinerant and opportunist traders are an important part of the business. Once arrived at the destination country, the paths that lead the raw material to Chinese processors (several multi-scale firms located in provinces like Shandong, HeNan, HuNan, HuBei, XinJiang, BeiJing and GanSu) are not documented.

A look at these "patchy landscapes"[1] (Tsing et al. 2019) modifies the usual Euro-American perspective on pharmaceuticalization, approached through the analysis of Northern leading multinational companies' strategies. Pharmaceuticalization has been a key concept in the sociology and anthropology of health and technology. First introduced by anthropologists (Nichter 1996), it has been used to characterize the process consisting in an increasing pharmaceutical conception of individual and social problems, and in the multiplication of pharmaceutical interventions to manage these problems. By "pharmaceutical conception of problems," one can consider the practice that tends to adopt a particular medical approach to personal and collective issues, supposed to be cured with chemical, pharmaceutical products. In that sense, "pharmaceuticalization" could be a more specific approach to the broader phenomenon of "medicalization" (Bell and Figert 2012). A large strand of social research on pharmaceuticalization has documented some of its concomitant processes like the growing influence of pharmaceutical industry on public policy (Abraham 2010), or the higher dependency of citizens on the entangled regimes of intellectual property and technical safety (Biehl 2007). In a nutshell, pharmaceuticalization covers a dual process of hegemony: on one hand, scientific and medical hegemony over the definition of social issues, and on the other hand, hegemony of the market forces over the way of solving these issues. Although some of the major consequences of this dual process have been analyzed, less direct ones have been left aside.

This is the case regarding the effects of pharmaceuticalization on non-human animal life. Backed upon the donkey skin and ejiao case, we argue that focusing on this would highlight some key aspects of the pharmaceuticalization mechanism as the joint expansion of science and markets. Pharmaceuticalization, indeed, is a process of expansion, as it can be seen in the intensification of knowledge production, acceleration of bench to market mechanisms, increase in international exchanges and a continuously extending consumer base. But this expansion also results in the growing use of resources and raw materials for production, among which the recruitment of animals. The use of non-human animal life in pharmaceuticalization needs to be understood more carefully. It highlights unrecognized dynamics and underlines how

[1] Landscapes where the morphology of humans and non-humans relations and structures change to accommodate or resist to social inequalities in face of globalization and environmental degradation (Tsing et al. 2019).

the seemingly undisputed and unilateral processes of concomitant expansion of science and market get affected by the use of animal matter. It also shows simultaneous environmental, political, and cultural tensions raised by the globalization processes affecting biomedical knowledge and products.

The use of animals or animal parts, tissues, products in medicine, and their characterization as pharmaceutical ingredients are almost inseparable from medical practice. In Antiquity, multiple substances were already in use for medicinal purpose, such as honey, butter, milk, eggs, urine, cobwebs, hare excrement, and so forth. Animal fat was frequently added as an excipient in various preparations (Olmer 2009). Some of these cures spanned over centuries, for example, leeches (Kirk et al. 2022) and beaver's secretions (Barbara 2008). The procurement of these animal resources has always depended on providers. They have been sustained through dynamic and sometimes prosperous trade practices, such as the ivory imported from the Swahili coast to the Chinese shore (Respess and Niziolek 2016).

We contend that the apparent marginality of the evolving ejiao industry compared to the most dominant pharmaceutical practices offers a very apt opportunity to describe feral pharmaceuticalization in its most fragile and contested dynamic, pertaining to knowledge production and legitimization, institutional recognition, environmental inscription, and cultural acceptance. It also seems relevant to consider the pharmaceutical nature of ejiao since most papers specifically dealing with the donkey trade for ejiao production leave aside the discussion about skin pharmaceuticalization and tend to emphasize animal welfare issues and the socioeconomic importance of donkeys to communities (i.e., Norris et al. 2021; Carder et al. 2019; Gameiro et al. 2021b; Farias et al. 2021; Skippen et al. 2021; Maigari et al. 2020).

In order to sustain what we call "feral pharmaceuticalization," we conducted a content analysis of two different corpuses of documents: (a) 63 scientific academic papers about ejiao published up to 2021 and available in the PubMed database; and (b) 342 news press articles containing the keywords "donkey skin" or "donkey hide," published from 2010 to 2021, and available in the Europresse database. The present paper also finds support in participant observation carried out during field research in Kenya,[2] in 2021. The first section of the paper borrows from a number of studies in medical history and the socioanthropology of human–animal relations in order to situate the context of pharmaceutical uses of animal life and to define what we call feral pharmaceuticalization. The second section stresses some of the mechanisms that tend to "domesticate[3]" the donkey skin business, explaining in particular how ejiao has been biomedicalized. The third section unveils on the contrary some features of the donkey skin market that allow us to say that despite these efforts, it remains somehow untamed. We conclude by indicating the interstitial character of the donkey skin trade, or the ferality of its pharmaceuticalization process.

[2] Nairobi, Kajiado, Kiambu, Narok and Nakuru counties.

[3] Trying to stay away from the various anthropological connotations of the word, we stick to a zoological definition of 'domestication', as the process of taming or adapting living beings for human use, here employed in a metaphorical way that expands from living beings to markets.

Animal life and the *pharmakon*

The feral qualities of pharmaceuticalization

We propose the concept of feral pharmaceuticalization to specify the tensions related to the intensified commodification, exploitation, and industrial circulation of animals pertaining to globalized pharmacy practices. The intensification of this use is coherent with rising animal use trends in other industries. In the food sector, for example, a 14%-growth is projected to the global consumption of meat proteins by 2030, compared to the average of 2018–2020 (OCDE/FAO 2021). In experimentation, about 50–100 million animals ranging from zebra fish to non-human primates are used every year (Badyal and Desai 2014). The use of animals in scientific procedures has increased from 2005 to 2015 (Taylor and Alvarez 2015). Such use intensification is simultaneous to contemporary discourses about animal welfare and compassion, and is even framed by them. The existence of this ethos is reflected and materialized in campaigns, politics, regulations, and innovations[4] for animal production, handling, and consumption. It accommodates the advocacy for the reduction of meat in our diets and the decrease of animal use in lab science with rising statistics associated to the growth of the world population.

The donkey skin trade shows a particularity in this scenario. This is the reason why we link it to feral pharmaceuticalization. It is feral in the sense that it lies in the interspace of what could be wild (completely unruled and out of control) and domesticated (with strong boundaries and limits). It has porous frontiers with these two poles, sometimes making efforts to fit into the domesticated side (for example, through the creation of standards answering to dominant medico-scientific requirements), and sometimes running wild (with illegal activities or local communities' opposition to governments' authorization for slaughterhouses opening, for instance). Another example of this "in-between" condition is the unstable character of laws ruling the production and the commerce of the donkey skin. For example, in countries like Brazil or Kenya, the slaughter of donkeys and the export of their skins are authorized and banned from time to time. Other features of this ferality will be better described in the next sections.

In ecology, "feral" applies to the individuals of a domestic species which regain a wild status, through processes directly related to the human behavior—as animal abandonment-, later reproducing themselves without human's interference (Gering 2019). In the field of human-animal studies:

> Feral refers to animals that are interstitial, conceived as in-between the wild and the domestic, animals that have escaped from domestication and recaptured some of the qualities of the wild. It also encompasses animals who are conceptually on the move, travelling between and never completely or comfortably fitting into categories. Feral animals are often problematic trouble-

[4] For example, plant-based meat, cellular meat, techniques for improving animal welfare in the agrifood industry, alternative experimentation materials and the 3R principles in testing, among many others.

some for the people who encounter them because they inhabit or are in flight from human spaces in an uncontrolled manner, often with direct consequences for the people associated with them (Marvin and McHugh 2014).

Ferality should not be understood as a fixed entity or condition, as it remains constructed in highly contingent ways in different cultures and at different times (Marvin and McHugh 2014). The term also points at an anthropological trend which is particularly alert to the encounters between industrial logics and environmental issues (Tsing et al. 2020), meaning something that is "caused by human action, but out of human control" (Tsing 2021). It is important to notice the human-associated character of feral in these definitions.

The notion of "feral pharmaceuticalization" draws from these works. It also walks side-by-side with what Chee (2021) called "faunal medicalization." The common point between the phenomena described by Chee and by us is that both of them deal with "a process potentially inclusive of all species, yet one that has arisen in relation to specific political contexts, economic imperatives, and inventive strategies with heretofore opaque origins" (Chee 2021). However, some features distinguish them. Contrarily to "faunal medicalization," defined as "the process of fashioning and refashioning animal-based drugs for service to Chinese state medicine and, in the import/export realm, the larger Chinese economy" (Chee 2021), our concept is not restricted to the use of animals by Chinese medicine, potentially applying to processes linked to other pharmaceutical uses than the Traditional Chinese Medicine. Moreover, Chee's approach highlights the efforts for regulating, controlling, and taming the use of animals by the Chinese medicine, while feral pharmaceuticalization underlines the "in-between" character of an activity that aims at domestication and simultaneously escapes it, through the uncontrolled and unpredictable "wild" behaviors entangled in the value chain.

The commodification of animal life for health

Several works have been documenting the commodification of animal life by and for science, technology, and medicine. A major field of study has concerned with laboratory animals and the use of animal life for the purpose of understanding and explaining biological life. The development of experimental medicine has been instrumental in the expansion of this practice, at the end of the eighteenth century and during early nineteenth century. Historians have focused upon vivisection as well as on the movements which raised their voice against it (Kirk 2019). Abigail Woods (2019) pinpoints that "the most widely recognized role that animals performed within medical history was that of experimental material." Multiple works in history of science and STS have documented the ambiguous relations between explaining animal life and making use of it, from primate studies (Haraway 1990) to the role of drosophila in genetics (Kohler 1994; Houdart 2008), and the use of animal models in reproductive sciences (Friese and Clarke 2012).

In close relation to experimentation and animal models, products of animal origin have been used as tools in healing practices. In addition to historical examples of animal trade and use quoted above, new medical practices with animal products

were the starting point of an industrialization of animal use. For example, in the eighteenth century, Edward Jenner resorted to biological products of the cow (vesicles) to immunize people against smallpox. A few decades later, Pasteur and Koch inoculated animals. These uses have called for the organization of intensive production methods. During the 19th and early 20th, these methods have been increasingly industrialized, as shown in the example of diphtheria serum extracted from horses studied by Simon (2008, 2016). According to Simon, individual horses were considered as "manufacturing units" in such a process. He also shows the entanglement of medical and experimental uses implied by such kind of exploitation: whereas horse factories were producing and providing large quantities of blood, thousands of guinea pigs were used to assess the quality of the horses' production.

From the end of the nineteenth century onwards, animal products were increasingly standardized for industrial production. This was also the case of animal themselves, building on the history of breeding practices, to massively produce laboratory animals (von Schwerin et al. 2013; Gradmann and Simon 2010). These large-scale and industrial production methods have been feeding medical markets, as illustrated by that of laboratory animals. Karen Rader presents the history of the Jax mouse and the "mouse factory" at the turn of the 1930s (Rader 2001) as one of increasing rationalization and commercial success, with mice being gradually standardized and sold on longer and longer distances.

The development of these industrial and commercial practices grew to a larger scale during the 1950s mirroring the structuration of the pharmaceutical industry. Animals were needed for toxicology testing. Kirk (2008), through his study of Rhodes Farm laboratories, has shown the creation of farms dedicated to the production of laboratory animals between the two world wars. The influence of Taylorism was important on such institutions as demonstrated in the case of the Wistar Rat (Clause 1993). These industrialization and commercialization processes, in return, influenced the standardization of laboratory practices (Kirk and Worboys 2011).

As a result of these evolutions, the use of animal life has become essential to contemporary biomedical practices. From laboratory animals such as mice and monkeys, to animals being used in the production of medicines such as snakes and pigs, non-human animals are present at every step of research and clinical practice. Multiple species take part in producing human health, even though they remain sometimes unacknowledged for such sacrifice, as is the case of the horseshoe crabs (Gorman 2020). A great variety of uses of animal life is therefore concurrent with the pervasive process of pharmaceuticalization.

The dilemmas of pharmaceutical animals

The pharmaceutical uses of animal life have raised a series of issues. A first important line of tension concerned the similarity of animals with humans, their relevance as either experimental subjects (in order to replicate experiments or treatments for humans) or biological material providers. One example is shown by the history of the use of lamb blood during the nineteenth century. Boel Berner (2020) shows that there was a wide panel of opinions on the question, from *finding species-alien blood*

quite similar to humans' and thus useful (as long as its blood cells were smaller than or the same size as those of human blood), to seeing it as so different that it was poisonous for the receiving organism (p. 129). Such use fed several controversies and relied upon particular conceptions of the animal nature. For instance, the promoters of the lamb's blood use viewed lambs as less specifically sheeps than older animals, based upon evolutionary biology views.

Berner's work additionally shows that these considerations about human/non-human similarity and technical compatibility also related to other debates on efficacy, dangerousness for humans, and non-human suffering. In that perspective, it is important to note that a second line of debate concerned the critique of animal use in medicine and curing practice. Protest movements already existed at the nineteenth century, objecting in the UK against vivisection and cruelty against animals. They contributed to legislative transformations, as the Cruelty to Animals Act was passed in 1876 (Tansey 1994). However, as Kirk (2008) notes, in no way such legislative initiatives had influence upon scientific practice. Medical research was most of the time placed in a state of exemption.

A third line of tension pertains to the quality of non-human animals as experimental material. The guinea pigs available during the interwar period raised concerns about results reliability as the experiments conducted with them were largely questionable. Kirk (2008) explains why this situation was largely related to the kind of market that had been structured for guinea pigs (private market, price driven, subject to frequent shortages and on which the sellers used to provide scientific institutions with aged or diseased animals with lower economic value). Tansey (1994) also discusses the existence of parallel markets for dogs during the 1920s, which favored dog theft and illicit practices in order to provide the scientific institutions with experimental subjects. Part of the issue was dealt with through the standardization of selected animals (Kirk 2008). In that perspective, these tensions, without being solved, were partly answered—or tamed—by the evolution of the market itself. Interestingly, this evolution toward more standardization has been indissolubly economic, moral and scientific.

The globalization of biomedical practice

These dilemmas point to some of the tensions involved in the use of animal life in modern science and biomedicine. They also make it clear that animals have historically been commoditized to serve these purposes—as well as to serve other industries, notably the food one. In these arenas, however, the employment of animals follows an industrial logic which implies the production (breeding and raising) of animals so that they will be available in a scalable and more than sufficient quantity to meet the demand, in an environment disciplined by rules and standards.

The feral pharmaceuticalization process, on its part, faces a serious scalability issue. The practices comprehended by this concept normally procure their animal materials in the natural or social environment where the animal lives in. In the case we describe in this paper, it means that feral donkeys are sourced out while they are roaming free, and working donkeys are sourced out in the rural and urban

communities they live in. Although some efforts to increase the supply of donkey by breeding and raising them for pharmaceutical use exist, they continue to be more a future project than a concrete measure, indicating that there is a will of going into the direction of large-scale production systems. This tendency can be seen in different degrees according to the value chain. For instance, donkey breeding farms for skin extraction purposes exist in China and they were supposed to be created in Latin American and African countries. But as far as we know, they are not a reality yet in these continents. Current donkey skin trade around the world could be considered an unscalable capitalist project (Tsing 2012), since it cannot expand without changing the system and leading to the exclusion of biological and cultural diversity. It would be part of an accumulation regime that takes advantage of value produced without capitalist control, or, in other words, that have "the ability to create capitalist value from nonscalable value regimes" (Tsing 2015; Centemeri 2015).

Tsing (2015) also accounts for the biological and cultural interactions between non-human nature and the increasing impact of human activity through the notion of "contaminated diversity." Matsutake mushrooms are an expression of contaminated diversity as they multiply in industrialized forests. In the same way, our notion of feral pharmaceuticalization tries to account for the interactions between pharmaceutical knowledge, the industrial exploitation of life, and the beings gathered through this process. It covers the increasing animal exploitation led by the use of pharmaceuticals in contemporary societies, through practices that are neither entirely wild nor entirely tamed.

In that sense, feral pharmaceuticalization is not limited to the industrialization of our relationship with animals (Baratay 2012). It does not try to account for the multiple innovations in breeding and crossing that have allowed for, as well as resulted from, such exploitation—a domain that has been strongly renewed since the nineteenth century with the development of zootechnics (Digard 2009). It mostly tries to grasp the human/non-human relations encompassed in the current process of pharmaceuticalization. It offers to account for the multiple controversies provoked by the thirst for animal life that goes with current pharmaceutical developments. It looks at the tensions arising from unscalable human extractive practices bearing on non-human beings in patchy environments—sites of intersectional multispecies inequalities, according to Tsing et al. (2019).

Non-human animals are affected by the expansion of pharmaceutical markets. At the same time, pharmaceuticalization itself, and the globalization of pharma markets are affected by the use of animal life. Several works (Druglitro and Kirk 2014) have shown the entanglements between industrialization, standardization, and globalization processes through the making of "transnational bodies." More generally STS works have shown the inclusion of these processes in global strategies of financialization of life (Haraway 2012). However, there are few works on the renewal of cultural, political, economic, and environmental tensions provoked by feral pharmaceuticalization. The growing role played by emerging and developing countries, in terms of production as well as in terms of consumption of industrialized products, invites us to study how these tensions are being rephrased. This is what we do now by turning to ejiao.

The taming of ejiao industry

Knowledge production and academic recognition

As explained in the introduction, donkey skin has been in use for a very long time in east Asia. Ejiao, as it is known in China, is the preparation made of donkey-hide gelatin, which can sometimes be mixed with other products. Today it is sold in the form of concentrate oral liquid, mixing powder for teas and soups, ready to eat tablets, cakes, skin creams, and others. Its consumption has increased in a substantive way during the last years. Following similar patterns to those observed in the case of herbal medicines (Pordié and Gaudillière 2014), it was "reformulated" on its way to industrialization. In other words, it has entered a specific regime of pharmaceutical consumption, structured by intellectual property rules, biomedical knowledge production, regulatory science and global health institutions. Ejiao has come to be "biomedicalized."

A first important feature of this biomedicalization concerns the growing production of scientific knowledge surrounding ejiao in biomedical journals. The PubMed database has identified 63 papers with the keyword "ejiao" until January 2021 (the first publication appeared in 1982), most of them (78%) concentrated in the 2014–2020 period, especially in the years 2019 and 2020. Out of the 63 papers, 18 were published in Chinese and 54 (71%) in English, the majority with authors affiliated to Chinese public and private research institutions (as universities or ejiao producing companies). Other institutions are from Japan and Taiwan.

The main thematic lines of this scientific literature are related to the results of ejiao application (medicinal properties), ejiao composition (identification of components and their properties), and the development or efficacy of mixtures or "compounds." In this sense, M. Liu et al. (2014) analyze a compound made up of donkey-hide gelatin and different types of plants, as ginseng, named Fufang e′jiao jiang (FEJ), used in clinic to replenish qi (vital energy) and nourish blood. Reviews show the chemical constituents (amino acids, proteins, volatile or inorganic substances, etc.) and bioactivities of ejiao (Li et al. 2006; Wang et al. 2014). Other subjects range from gene variation in Chinese donkeys (Sun et al. 2017) to the characterization of aroma-active components of donkey gelatin according to geographical origins (Zhang et al. 2018).

Most of the studies define ejiao as a widely used traditional Chinese medicine (TCM), with a long history of successful application (Wang et al. 2014; Wu et al. 2016). The biological activities of the ejiao and its compounds might include antitumor activity, immunomodulatory activity, bone repair activity, anti-inflammatory activity, and antifatigue activity (Wang et al. 2014). Effects considered important on blood disorders and blood activities were identified (Li et al. 2019a, b, 2016), with relations to the immune defense mechanisms and tumors resistance (Shen et al. 2016; Xu et al. 2014, 2018). Anti-aging effects on the skin are claimed in a paper showing that ejiao accelerates wound healing, as well as prevents ultraviolet collagen synthesis decline and wrinkle formation (Xiao et al. 2020a).

From a neurological perspective, papers indicate that *Colla corii asini* might delay aging-induced degenerative changes in neurons and might be useful for preventing and treating Alzheimer's disease (Xiao et al. 2020b). Highlighting that scientific production is also embedded in cultural references, a recent study explored the possible benefits of traditional Chinese medicine—including ejiao—on psychological and mental disorders of Covid-19 survivors. It asserts that TCM could restore the balance of Yin and Yang in human body to treat depression, anxiety, and post-traumatic stress related to Covid-19 (Ma et al. 2020).

In addition to studies on the potential benefits of ejiao, others address issues related to market regulation through technological tools. In particular, as a result of ejiao's market growth, the multiplication of substandard and counterfeit products has become a concern, which is a common feature for growing pharmaceutical markets (Quet 2021). Researchers are developing methods for quality control and/or the detection of donkey-hide gelatin adulteration (Li et al. 2019a, b; Li et al. 2017; Liu et al. 2020; Sheu et al. 2020). Addressing the supply shortage of donkeys, one paper suggested the development and research of gelatin derived from other animal skins, as the so-called "new gelatin" (or Xin'ejiao in China), made from the skin of pig (Han et al. 2019). The substitution of materials in TCM, however, is complicated by the fact that TCM reinforces the idea that certain specific ingredients produced in specific locales are considered superior in quality and clinical effectiveness than others (Cheung et al., 2021).

Even if for thousand years the use of ejiao was based on the empirical perception of its benefits, transmitted as cultural heritage or belief by those who shared the same symbolic structure in geographically limited borders, the feral pharmaceuticalization process we describe here implies a new logic. This logic requires the use of biomedical institutions to legitimize its applications and, therefore, the outsourcing of raw material. The expansion of the Chinese market for ejiao requires the enrollment of a wider variety of stakeholders at an international level such as farmers selling the donkeys and the governments. It appears that one way of consolidating this process—and domesticating it—is through scientific legitimacy. However, science itself is embedded in social controversies. The biomedicalization of donkey skin and the globalized circulation of the related commodities could hardly be done without the construction of a technoscientific framework which tries to dissipate critics about its non-scientifically proved nature, so that ejiao can integrate a modern "tamed" pharmaceutical regime.

Science, industry, and the State

The production and popularization of biomedical knowledge commented above has been supported by two major actors: the ejiao industry and the Chinese government. This is aligned with the dual hegemony processes covered by pharmaceuticalization: the health-medical power over the definition of social issues, as well as the power of market over the solution of such issues. In fact, with globalization, demonstrating the efficacy and safety of Chinese medicine has become a major preoccupation of

the institutions that support it, materialized in the creation of a network of laboratories and test protocols, laws, and regulatory bodies (Chee 2021).

In the ejiao case, besides sponsoring and/or conducting scientific research, the presence of these major actors is also noticed through their efforts to create a dialog with consumers, particularly after 2015. In that year, a trade association for ejiao was created by the Chinese leading producing company (Dong-E E-jiao Co. Ltd., here referred as DEEJ), in order to establish industry standards and product authenticity (Conrad 2019). Other actions included the promotion of TCM in international fairs, the organization of the First International Symposium on Donkey Science,[5] as well as the promotion of "industrial tourism" through the launching of the DEEJ Biotech Park. The park, located in the Shangdong Province, received 300,000 visitors in 2017 and is a building complex that holds DEEJ pharmaceutical plant, a visitor center, product showroom and a museum (the China Ejiao Museum) that allows visitors to take part in interactive exhibits, taste products, and witness the manufacturing process (Wyatt Design Group 2017). Around the museum, Dong'e county was set up to receive tourists as an ancient village with replicas of old buildings, a bet on the "culture marketing" aimed to "counteract negative stories about ejiao" (Conrad 2019).

On December 2019, the 13th edition of the Dongzhi Ejiao Festival was held in Dong'e County, known as "ejiao's birthplace," in the Shandong Province. New products were released during the event, increasing the lines of marketable food and drinking ejiao products. This was also the occasion for the DEEJ to issue the Ejiao Quality Standards and the Declaration of Integrity, together with trade organizations and major national R&D, production and testing organizations. According to a press-release, these documents will further "standardize the industry regulations and regulate the ejiao market, thereby better ensuring the quality of ejiao products, promoting the high-quality development of the ejiao industry and supporting the healthy development of the TCM industry" (DEEJ 2019).

Standardization practices have been instrumental in the handling of tensions pertaining to technical, economic, and moral considerations related to the use of animal life in medical and pharmaceutical practice for long. The growing use of laboratory mice from the beginning of the twentieth century has turned them into operators of uniformity and generality (Logan 2002)—a process of anonymity and de-individuation of animals already on its way during the nineteenth century (Cunningham and Williams 1992). Taylorist methods and scientific management went together with this process (Clause 1993), which also resulted from management techniques and from the industrialization of animal breeding (Kirk 2019).

Regarding ejiao, scientists and industry members recognize that manufacturers use different raw materials and processes, taking profit of the relative lack of regulatory standards in the Chinese Pharmacopoeia. The quality of the products, therefore, varies wildly, which would affect medical efficacy and prices (Li et al. 2016)—an indication that indiscipline, in this sense, is not good either for business, nor for the sector's image. Li et al. (2016) describe ejiao as "a precious traditional Chinese

[5] https://www.sciencedirect.com/journal/journal-of-equine-veterinary-science/vol/65/suppl/C.

medicine widely used in China for thousands of years." The authors affirm that manufacturer identification and storage time determination are critical issues for the industry; they sustain that Dong'e Ejiao (DEEJ) is one of the brands with the highest quality in the market.[6] "Vendors urgently need a way of discriminating Ejiao for the purpose of brand protection and competitive advantage," says Li et al. (2016, p. 383). We can interpret this assertive as evidence of the importance of technical standardization for taming ejiao's economy.

The Chinese State has accompanied these efforts, albeit in a more contradictory fashion. Looking at the global level, in 1996, China introduced the concept of "internationalization of TCM[7]" comprising two major aspects: (a) the importance of expanding the volume of import and export of TCM in order to promote TCM international trade and to foster its market share across the countries; (b) the establishment of a legal status of TCM in overseas countries in order to ensure reasonable market entry and development under the protection of local laws and regulations (Lin et al. 2018).

This national strategy was reinforced by the state government in 2016, when it promised universal access to traditional practices by 2020 and a booming industry by 2030, including the support to TCM tourism (Cyranoski 2018). It exposes how the non-scalability of supply tends to remain critical for pharma animal-based value chains.

The Chinese herbal extracts were the largest and fastest growing item among all Chinese pharmaceutical products in 2015 (Lin et al. 2018). TCM was exported to 185 countries and regions in 2016, but its main markets continued to be located in Asia, where the target markets are Hong Kong, Japan, Malaysia, South Korea, and Indonesia. However, the United States is expected to soon become the largest market of TCM (Lin et al. 2018). Worth around USD 50 to 60 billion a year, the TCM market has grown at about 11 percent annually (Master 2019; Cyranoski 2018). Ejiao is, therefore, inserted in a rationality of TCM expansion and internationalization that requires the acceptance and recognition of its technical patterns and standards to fit into global trade rules, although the large majority of its consumption occurs within the Chinese territory.

Ejiao in the realm of international public health

The combined efforts of medical scientists, industrial players, and government officials have not been in vain. In 2019, the governing body of the World Health Organization, the World Health Assembly, formally approved the latest version of its global compendium (the International Classification of Diseases code, the global standard for diagnostic health information), with the inclusion of a chapter on traditional medicine for the first time (Hunt, 2019). The move raised a lot of controversy, with strong declarations from the western scientific community against it. The

[6] Scientists with affiliation to the DEEJ are among the authors.

[7] TCM encompasses a wide range of items: traditional Chinese medicinal materials, decoction pieces, Chinese patented medicines, herbal extracts, and health care products (Lin et al. 2018).

Scientific American journal (from Springer Nature publisher), for example, affirmed that traditional medicines are unregulated in China and frequently make people sick, rather than curing them. It adds: *the proliferation of traditional medicines would have significant environmental impacts on top of the negative health effects. It would contribute to the destruction of ecosystems and increase the illegal trade of wildlife* (Editors 2019).

Lobbying and the strong presence of Chinese representatives in lead WHO positions have been pinpointed as one of the reasons for the current acceptance of TCM by the organization (Procopio 2020; Callick 2020; Cyranoski 2018). From 2006 to 2017, the Chinese-Canadian physician Margaret Chan Fung Fu-chun served as the Director-General of the WHO, delegating to the People's Republic of China. This can be understood as part of a broader process currently at work in China. According to Micollier (2015), the 2000s was a period of renewed interest for Chinese traditional and popular knowledge and practice, both material and immaterial patrimony, and on norms and rules. This is visible on an international scale through the increasing Chinese soft power.

In 2020, the draft of the "Beijing Chinese Medicine Regulations" went online, with a chapter "Protection and Inheritance of Traditional Chinese Medicine" calling for the punishment of anyone who would slander traditional Chinese medicine in any way. "This law would be the first of its kind in China to outlaw the criticism of TCM; however, it is emblematic of a wider effort by Chinese leadership to leverage TCM to strengthen their economy at home while improving their soft power influence abroad" (Collins 2020). In that regard, the biomedicalization of ejiao also results from a combination of scientific investigation, industry promotion, government support and regulation, and international organizations acknowledgement.

Wild remnants: the uncertainties of feral pharmaceuticalization

The continuous evolution of TCM sector as a medical system and as a commercial industry presents challenges for species that are overexploited, particularly due to the expanding scale of demand and consumption. Chee (2021) reminds that even exotic or domestic species with no prior "medicinal" status have been targeted by TCM, especially due to globalization. As examples, the gills of manta rays—a multimillion-dollar market whose creation is attributed to Chinese seafood salesmen, in face of a declining shark fishery—or the blood of chickens, which became one of the most important animal drugs during the Cultural Revolution (1966–1976). The new curative powers of both familiar and unfamiliar species have also emerged in other Asian countries, as shown by the case of rhino horns used as a hangover cure by elite businessmen in Vietnam.

For some species, exploitation at the rates required by market demand is not sustainable because of biological factors, such as low reproductive rate, slow growth, endemic, climate change sensitive (Cheung et al. 2021). This is considered a very serious issue for wild species, whose breeding is not human controlled, but it can be similarly verified in the case of animals whose breeding activities do not follow an industrial scale. The current exploitation of donkeys in TCM is an example.

As previously stated, the environmental impacts of donkey's utilization as the main raw material for ejiao production is highly criticized, combining concerns that range from animal welfare to biodiversity conservation.

The main actors who carry on these critiques are animal protection non-governmental organizations, especially those dedicated to donkeys and horses welfare, as well as news media. The coming paragraphs shade light on these critics to show the "wild" side of feral pharmaceuticalization. It is worth pointing out that this wild side of the donkey hide trade refers to the refusal of obeying rules that could transform this "emerging business" into a "tamed marked" (with solid norms and controlled practices and standards). It has a dual nature: at the demand side, it tends to be wild because of the savage exploitation of the raw material (for example, sourcing out donkeys in a unsustainable, disorganized and often illegal way, and with a lack of respect to principles of animal welfare); at the supply side, it tends to be wild when human and non-human actors resist the forces that try to incorporate them into the market, resisting to submit to it.

The discursive and empirical elements of the feral pharmaceutical "wildness" presented in the sequence are, therefore, the result of a qualitative content research[8] based on news press articles from "Europresse" database for the period between January 1st 2010 and January 1st 2021. We searched for articles with the keywords "donkey skin" or "donkey hide," and excluded the words "theatre," "film," "movie," and tale" from the whole text.[9] The search comprised all the news sources covered by Europresse, but excluded the categories "television and radio, social media, studies and reports, repertories and references." As a result, 353 articles were identified, 11 of them being later disqualified by us because they were not actually published by news press. In total, 342 articles compose the effective corpus analyzed and cited in this paper.

Animal welfare and biodiversity at stake

As far as the species conservation is concerned, the arguments identified in news articles generally confront the high Chinese demand with the limited supply of donkeys in Southern countries. They show that the scale of production cannot expand without depleting natural resources. Numbers are frequently presented in order to give a concrete dimension to the situation, as in this example: "The Africa Network for Animal Welfare estimates that Kenyan donkeys will be wiped out by 2023 owing to high demands for their skins in China" (Marindany 2020). The Farming Systems Kenya chief executive raised fears of donkey disappearing in a decade if the ongoing rate of slaughter was maintained and considering the specie's long gestation period (Mwangi and Sayagie 2017). A survey conducted by Kenya's Agricultural and

[8] Corroborated by ethnographic observation from 2019 to 2021, in rural and urban communities of Brazil and Kenya.

[9] "Donkey Skin" (Peau d'âne) is a famous fairy tale written by Charles Perrault and first published in France in 1695. Inspired by this tale, a musical fantasy comedy film directed by Jacques Demy was released in 1970, starring Catherine Deneuve and Jean Marais.

Livestock Research Organization in 2019 showed that around 302,000 donkeys were slaughtered between 2016 and 2018 in the countries' four slaughterhouses (Ngotho 2020).

Large NGOs studies or campaign reports frequently contribute to estimates of the global skin trade, as the "Under the Skin" report, first launched in 2017 and updated in 2019 (The Donkey Sanctuary 2017, 2019). The British organization calculates that the ejiao industry is able to source approximately 1.8 million skins domestically (in China), and the remaining 3 to 3.5 million are sourced through the global donkey skin trade. This international market is composed of a set of diverse and constantly evolving practices according to the official status of slaughter activities in each country. It can assume the form of illegal large-scale slaughter (from 650,000 to 1,000,000 donkeys in Nigeria/year); legal large-scale slaughter (390,000/year in Kenya and 208,000/year in Brazil); smaller slaughter operations (in Tanzania and South Africa); legal trade with no reliable export data (Mauritania, Mexico, Peru, and Egypt); and illegal slaughter of smaller dimensions (Ghana and Ethiopia) (TDS 2019).

The use of animal parts—especially wild and endangered species[10]—is particularly sensible for TCM, who has a long tradition in using rare and expensive animals in food and medicine (Gardner 2007; Master 2019). According to some authors, in the absence of other therapeutic alternatives, the use of certain animal remedies could be justifiable in the past, when trade extent was limited and the animal species were plentiful in their natural habitat. But in "our modern, globalized and technically advanced world," this traditional approach is no longer sustainable (Still 2003). Moreover, "misinformation regarding the therapeutic efficacy of animal-derived substances has led and currently leads to problems with wildlife preservation and animal ethics" (Eigenschink et al. 2020).

The discussion returns to the credibility of TCM. Scholarly output designed to corroborate ejiao's virtues coexists with doubts or skepticisms about the medical relevance of ejiao. Culturally constructed differences between the understanding of health/disease concepts in TCM and in biomedicine, specially related to blood deficiency, can be pointed as a reason to criticize the efficiency of ejiao in enriching blood. But questions about the biochemical properties of the raw material are highlighted as well. As an example, the lack of 'tryptophan,' an amino acid that plays a part in the synthesis of proteins, would make donkey skin gelatin an inferior, less nutritious, substance (Wen 2018). Other claims that illegal additives used to reduce ejiao costs may be harmful to the human health in the long term and that the lack of specific medicinal properties in the donkey skin (similar to many others

[10] Some internationally published textbooks of TCM still recommend the medical use of animal products, as tiger bones, horns of rhino, antelopes, cattle and goats, bovine calculi, antlers of various deer species, testicles and penis of the dog and parts of reptiles. The medical use of the above products is described primarily in terms of TCM symptomatology (Yin and Yang, Excess and Deficiency, Five Element Theory, etc.), without scientific justification (STILL 2003).

animal skins) would provide it little capacity for increasing white blood cells and platelets"[11] (Humane Society International 2018).

Investigating the role of donkeys in human history, Mitchell (2018) states that donkeys feature in the recipes used in traditional Chinese medicine with a wide variety of effects supposed to be associated with donkey gelatin, tissues, and body parts. Yet, *none are valid, but trade in donkeys for these purposes continues today* (Mitchell 2018, p.80). About 13% of the medicines used by TCM are derived from animals but *the clinical use of these preparations is often based on tradition and belief, rather than on evidence of efficacy* (Still 2003, p.118). In face of the threats to biodiversity and animal welfare, Still (2003) suggests that the description of medicinal use of animal products in the professional and lay literature should be strictly limited to the very few legally and ethically justified cases, and that historical quotations should be put into proper context. The limited availability of donkey as extractive resource reinforces the unscalability of donkey business and arises local conflicts and controversies, as shown in the next topics.

Threatening livelihoods

In addition to environmental and animal welfare concerns, reports coming from Kenya, Ethiopia, and South Africa show how global trade is socially affecting people who rely on donkeys to support their livelihoods (Obi, 2019a). Comparing the monthly revenues provided by donkeys work on Kenyan rural communities and the revenues obtained from Kenyan donkey meat and skin exports, a report from The Brooke affirms that the income foregone was valued at KES 28.3 billion during the period of April 2016 to December 2019: "a comparison of the income foregone by donkey owners and users was 15 times more than the gross revenue generated from export of donkey meat and skin" (Maichomo et al. 2019). In another report, the organization describes the contribution of working equines to people livelihoods as going far beyond money earning, and comprising the transport of children to school, the support to women daily household activities, the provision of manure to agriculture fields, among many others (Brooke 2015).

The exploitative costs, lucrative skin business for traders, and declining donkey populations are the reasons used by the Kenya Veterinary Association to classify the donkey trade as not sustainable and to call for a total ban on trade, since it hurts both humans and donkeys (Murage 2017). The decreasing donkey population would also be a threat to food security and nutrition of rural dwellers. Botswana's Assistant Minister of Agricultural Development and Food Security declared, in 2017, that donkeys provide a key source of power and income, making it easier for families to access food and services. With two licensed slaughter facilities able to export donkey hides in the country at that moment, he urged public to be sensitized on donkey welfare and benefits derived from rearing donkeys (Thatayamodimo 2017).

[11] The report of Humane Society International mentions media press articles as sources of information, and no scientific papers.

Examining the income benefits provided by donkeys to the livelihoods of rural households in Northern Ghana, Maggs et al. (2021) concluded that donkey contributions are significant and more complex than previously understood and documented in the literature. "Donkey ownership confers up to six different income benefits in comparison to non-donkey owners" (Maggs 2021). Female owners of donkeys reported that donkeys can contribute between 30 and 60% of their income, and children of both sexes can play an important role in the efficient deployment of one of these income generating activities, according to the authors (Maggs, 2021). In rural and urban Ethiopia, donkeys' work enables their owners and users to generate income, but also allows a degree of security for people who live in vulnerable and impoverished situations (Geiger et al. 2020). Geiger et al. (2020) identified that the income resulting from donkeys' work is spent at buying food stuffs and school materials for children, purchasing additional livestock, repairing or building homes, and/or participating community-based saving schemes.

These data stress how animal materials and lives are linked to technoscientific practices in "increasingly complex, multisited, multidirectional processes of medicalisation that today are being both extended and reconstituted" (Clark et al. 2003, p. 162). Feral pharmaceuticalization is the expression of the socioenvironmental consequences of a globalized regime of commodities circulation that gains ground when health becomes a moral imperative, allowing the creation of capitalist value from "nonscalable value regimes" (Tsing 2012). The indocility of the process is clearly seen in the patchy sites where intersectional inequalities take place among humans. The health, the welfare, or the wellbeing of animals and humans implicated in the outsourcing activities of this productive chain do not count on the same scale that those of the consuming side. In this sense, the feeling of "care" that comes along with products aimed to improve beauty and life quality does not apply to ejiao's production and consumption sides in a balanced manner.

Wavering regulatory practices

While some governments see donkey skin trade as a threat, others understand it as an economic opportunity for job and income generation. In Namibia, for example, the Deputy Minister of Economic and National Planning said the installation of abattoirs could add value to the country's economy. According to a news article, plans of setting up donkey abattoirs in Namibia were underway, and ahead of community's fears of donkey thefts, the deputy minister ensured the abattoir would be regulated by law. He added that the facility would not accept any dishonesty about the ownership of livestock, concluding that this could be a good opportunity for Namibia to bring in foreign currency (NAMPA 2017).

But if the benefits are clearly seen by one side, cultural or social interdictions may prevent it from being achieved from another. In this sense, the regulation of donkeys' slaughter raises conflicts between the different parts concerned, such as investors, local communities, and different levels of public administration. In Ethiopia, a slaughterhouse owned by a private Chinese company started operating in early April 2017."Experts from China will carry out the slaughter day to day […]

The meat will never have any contact with locals", said the communication head of the Food, Beverage & Pharmaceutical Industry Development Institute, from the Ministry of Trade and Industry. It adds that the company would employ 215 locals and create an opportunity to amass revenue for farmers supplying the abattoir with the animal (Berhane 2017). On April 16, 2017, the Bishoftu city administration banned the Chinese company from carrying on with its operations, saying that it was offensive to the people who lived around the plant. Since public outrage exploded on social media platforms three weeks before, the city administration claimed they feared unrest and property damage, and "ordered the closure of the abattoir for the sake of the investors themselves" (Addis 2017). The company then, complained about all the lost investment: it had costed 80 million Br (local currency) to build the new plant, which took two years to be ready, employing 300 local people in the construction. The company said it had a license to operate issued by the previous city administration council, but the Ethiopian Investment Commission made it clear that such investments have not been accepted since 2014: "other than those registered before 2014, we don't allow such investments anymore. They are not in line with societal values and culture." The company claimed for respect and said it would continue to carry on with the business until it had slaughtered all the stock of already purchased donkeys. About 65 of the company's employees signed a petition asking the city administration to abandon the ban (Addis 2017), showing the conflicts that arise when different globalized and local interests and moral values meet together in a territorialized space.

Along with cultural and religious interdictions to the donkey trade—for example, consuming food containing donkey and horse sources is forbidden ("haram") for muslims (Wang et al. 2014), illegal activities such as donkey smuggling and theft unveil another layer of sociopolitical tensions around donkey hide commodification. Many cases are reported, from donkeys stolen from communities to illegal shipment in ports and airport customs. In Kenya, statistics from police and veterinary departments in Nakuru, Narok and Nyandarua counties show that more than 600 donkeys have been stolen in the region from January to September 2017. According to the police, criminals have shifted their interest from cattle to donkeys, sending the skins to China, and local residents organized marches to protest the increasing donkey theft (Macharia and Sayagie 2017). In Nigeria, where the export of donkey products is forbidden, the Federal Operation Unit (FOU) of the Nigeria Customs Service went to the Murtala Muhammed International Airport Command (MMIA), Lagos, to seize donkey skin said to be worth N 7.2 billions (local currency) in 2019, with suspicions (denied by the NCS head) regarding the participation of customs agents and terminal operators in potential trade facilitation (Nation 2019).

Still, in relation to conflicts associated with legitimate or illegitimate forms of interaction between humans and non-humans, we can mention the cases of animal cruelty linked to the skin supply, as animal malnutrition, mistreatment, cruel slaughter methods, and others (Mercury 2017; AFP 2019). These acts are framed as crime in many countries, as well as the practices of imitation and counterfeit that came after the shortage of donkey hides in China. The proposal of scientific methods of quality control and material identification was discussed earlier in this paper; they represent biotechnical responses to frictions that go along with the use of animal life

by the pharmaceutical industry, transformed in economic value: "a donkey skin can cost up to 3000 yuan, while horse and mule hides are only 200 yuan each. Pig skins are even cheaper […] Some products don't even have any ejiao in them" (Xinhua 2016). The counterfeiting or falsification of products is a well-known problem in the pharmaceutical industry, raising issues related to capitalist industries' power, norms and control strategies, dynamics of merchandise circulation (Quet 2021). When animal life is used as raw material, it also concerns the implicit and explicit distinctions between the sources—and, therefore, the lives—that deserve to be more or less valorized, explored, or protected.

Moving up to another level of the "feral" market regulation, the accumulation of concerns related to donkey trade led to a slaughter ban in several African countries, indicating the existence of dynamic power relations. Uganda banned it in 2017, claiming the rising demand for donkey products in the Far East was decimating donkeys throughout Africa (Murage 2017). By 2019, 18 countries had taken action to ban donkeys exports, many due to concerns about the security of their donkey populations, the risk of disease spread and the impact on livelihoods. International nonprofit organizations, such as The Donkey Sanctuary, Brooke and the Society for the Protection of Animals Abroad (SPANA) work with national governments and local communities, lobbying to ban donkey trade. Burkina Faso, Ghana, Uganda, Tanzania, Niger, Nigeria, Mali, and Senegal are examples of countries who had banned donkey skin exports (The Donkey Sanctuary 2019). In Nigeria, a bill prohibiting the killing and the export of donkeys or its carcasses or derivatives was set up in 2018, because of the depletion in numbers and threat of donkey extinction, as well as "their aesthetic, ecological, educational, historical, recreational and scientific value to the nation and the people" (Nation 2018). In Kenya, Agriculture Cabinet banned the slaughter and export of donkeys in February 2020, following an uproar from owners over increased thefts due to the high demand of their meat, skins, and hooves (Ngotho 2020). In May 2021, the ban was lifted and the slaughter reauthorized (Kimuyu 2021). Actually, the resistances to globalization through local conflicts and controversies are a feature of the donkey skin business ferality, relating these episodes to its unscalability.

Conclusion

Although pharmaceutical uses of animal life have been a constant feature in the history of medicine, their role and organization have largely evolved along the years. From the late eighteenth century, they have been gradually industrialized. New tools and new techniques have been put in place, as well as new modes of organization. Production and extraction processes followed increasingly segmented approaches in increasingly diverse sites. The volume of international trade in animal life for medical purpose grew up with the standardization of products, through the creation of organizations dedicated to its regulation, such as the World Health Organization (WHO), the World Organization for Animal Health (OIE), the Convention on International Trade of Endangered Species (CITES). In that regard, the historical evolution of the trade in animal life for medical purpose has been partially marked

by technical rationalization: standardization of processes, financial optimization of operations, and atomization of production and distribution. However, a closer look at these processes reveals a more complex picture. The intensification of market logics surrounding trade in animal life also raises contradictory situations and specific tensions that deserve careful scrutiny, and to address it we propose the notion of feral pharmaceuticalization.

Situated in the in-between of wild and tamed capitalist processes, feral pharmaceuticalization helps us to highlight tensions over epistemic and healing models, human and non-human welfare, environmental management, regulatory policies, cultural and politico-economic relations, and ways of exploiting animal life. Circumscribed in time and space, it allows to unveil cultural and geopolitical differences and conflicting anthropocentric visions and beliefs on what is legitimate or not about human's use of animal life. It also highlights the wild and somehow undisciplined condition of this kind of pharmaceuticalization, constrained by human attitudes and simultaneously rebellious to them, resulting in animal's uncertain fate.

The efforts to domesticate ejiao's industrialized production with scientific legitimation, legal apparatuses, and technical production and quality standards co-exist with savage practices in the procurement of raw materials and, on the other side, with collective public oppositions to the legal operation of slaughterhouses. Since donkeys are generally neither bred nor raised for pharmaceutical use, contrarily to food or experimentation animals, a strong competition emerges in multiple patchy environments. The disputes toward this limited supply availability is a key subject in feral pharmaceuticalization and denotes the unscalability of its processes.

The conflicted donkey skin trade illustrates the complexity and fragility of this phenomenon. It tends to show that pharmaceuticalization cannot be reduced too hastily to a combined process of science and market hegemony. Although biomedical and market logics are a key to understand how ejiao became a highly sought-after commodity and how it restructured donkey supply at a global level, they cannot be considered in isolation. They should be put in relation with the broader changes that have affected the expansion of products, people, and beliefs circulation; the major changes in scales regarding exploitation of non-human life; the emergence of Global South industrial market players; and the emergence of developing countries as producers and consumers of industrially manufactured pharmaceuticals.

This debate underlines that the pharmaceuticalization expansion—and more generally economic globalization's transformative power—is more contested than it would seem at first sight, even in unbalanced South to South circulations. The feral pharmaceuticalization process points, overall, to the problematic articulation of three sets of norms which concurs to establish what is medically sound, what is environmentally sustainable, what is acceptable in the use of animal life. Moreover, it questions who the social actors in position to legitimize these norms are, and what kind of power resources they mobilize. These sets of norms are geographically and culturally situated and the conflicts raised by feral pharmaceuticalization suggest that there is no conclusive way to establish their relations. Economic power and geopolitical strategy can produce an illusion of pacification; but in no way can they lead to a definitive stabilization of globalized relations.

However, this case study should not obliterate the wide range of feral pharmaceuticalization. Although the donkey skin trade sheds a particular light upon the tensions and fragilities of the process, one should acknowledge that to be feral, pharmaceuticalization does not need to relate to so-called "traditional" practices. The capture of horseshoe crabs, the extraction of snake's venom, the breeding of macaques, to mention but a few activities, are strongly linked to the biomedical industries—and yet they fall under the feral pharmaceuticalization process. In that perspective, our case study is only an attempt to lay a few conceptual bricks of understanding of a situation in which health technology, non-human and environmental welfare, and social norms are closely entangled. Anthropocentric values and definitions of the use of non-human lives are at the core of feral pharmaceuticalization processes. These processes shape unpredictable configurations of economic relations through a blend of sociocultural resistance and market acceptance. There is still a long way to go before fully understand the variations of these configurations.

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References

Abraham, John. 2010. Pharmaceuticalization of Society in Context: Theoretical. *Empirical and Health Dimensions, Sociology* 44 (4): 603–622.

Badyal, D.K., and C. Desai. 2014. Animal Use in Pharmacology Education and Research: The Changing Scenario. *Indian Journal of Pharmacology* 46: 257–265.

Baratay, Eric. 2012. *Le point de vue animal*. Paris: Une autre version de l'histoire.

Barbara, Sébastien. 2008. Castoréum et basilic, deux substances animales de la pharmacopée ancienne. In *Le Médecin initié par l'animal Animaux et médecine dans l'Antiquité grecque et latine*, ed. Isabelle Boehm and Pascal Luccioni, 121–148. Lyon: Maison de l'Orient et de la Méditerranée.

Bell, Susan E., and Anne E. Figert. 2012. Medicalization and pharmaceuticalization at the intersections: Looking backward, sideways and forward. *Social Science & Medicine* 75: 775–783.

Berner, Boel. 2020. *Strange blood. The rise and fall of lamb blood transfusion in 19th century medicine and beyond*. Bielefeld: Verlag.

Biehl, João Guilherme. 2007. Pharmaceuticalization: AIDS treatment and global health politics. *Anthropological Quarterly* 80 (4): 1083–1126.

Carder, G., O. Ingasia, E. Ngenoh, S. Theuri, D. Rono, and P. Langat. 2019. The emerging trade in donkey hide: An opportunity or a threat for communities in Kenya? *Agricultural Sciences* 10: 1152–1177. https://doi.org/10.4236/as.2019.109087.

Centemeri, Laura. 2017. Review de Anna Lowenhaupt Tsing. *Italian Journal of Science & Technology Studies, STS Italia* 8 (1): 159–162.

Chee, L.P.Y. 2021. *Mao's bestiary: Medicinal animals and modern China*. Durham: Duke UP.

Chiwome, B.A., B. Mushonga, V. Mbeserua, A. Samkange, P. Mbiri, O. Madzingira, and E. Kandiwa. 2019. Perceptions and welfare of donkeys in Southern Namibia. *Journal of Veterinary Science and Animal Welfare* 3 (1): 44–56.

Clause, Bonnie T. 1993. The Wistar rat as a right choice: Establishing mammalian standards and the ideal of a standardized mammal. *Journal of the History of Biology* 26: 329–349.

Cunningham, Andrew, and Perry Williams, eds. 1992. *The Laboratory Revolution in Medicine*. Cambridge: Cambridge University Press.

Digard, Jean-Pierre. 2009. *L'homme et les animaux domestiques. Anthropologie d'une passion*. Paris, Fayard [1990]

Druglitro, Tone, and Robert G.W.. Kirk. 2014. Building Transnational Bodies: Norway and the International Development of Laboratory Animal Science, ca 1956–1980. *Science in Context* 27 (2): 333–357.

Eigenschink, Michael, Lukas Dearing, Tom E. Dablander, Julian Maier, and Harald H. Sitte. 2020. A critical examination of the main premises of traditional Chinese medicine. *Wiener Klinische Wochenschrift* 132 (9): 260–273. https://doi.org/10.1007/s00508-020-01625-w.

Farias, S., et al. 2021. Case report: The use of the AWIN welfare assessment protocol to monitor a group of abandoned donkeys. *Brazilian Journal of Veterinary Research and Animal Science* 58: e174701.

Friese, Carrie, and Adele E. Clarke. 2012. Transposing bodies of knowledge and technique: Animal models at work in reproductive sciences. *Social Studies of Science* 42 (1): 31–52.

Gameiro, M.B.P.G., C. Clancy, and J.A. Zanella. 2021a. Between freedom and abandonment: Social representations of free-roaming donkeys in the Brazilian Northeast. *Anthrozoös*. https://doi.org/10.1080/08927936.2021.1999607.

Gameiro, M.B.P.G., V.T. Rezende, and J.A. Zanella. 2021b. Brazilian donkey slaughter and exports from 2002 to 2019. *Brazilian Journal of Veterinary Research and Animal Science* 58: e174697. https://doi.org/10.11606/issn.1678-4456.bjvras.2021.174697.

Martha, Geiger, Hockenhull Jo, Buller Henry, Tefera Engida Gebre, Getachew Mulugeta, Burden Faith Adelaide, and Whay Helen Rebecca. 2020. Understanding the attitudes of communities to the social, economic, and cultural importance of working donkeys in rural, peri-urban, and urban areas of Ethiopia. *Frontiers in Veterinary Science*. https://doi.org/10.3389/fvets.2020.00060.

Gering, E., D. Incorvaia, R. Henriksen, J. Conner, T. Getty, and D. Wright. 2019. Getting back to nature: Feralization in animals and plants. *Trends in Ecology & Evolution* 34 (12): 1137–1151. https://doi.org/10.1016/j.tree.2019.07.018.

Gorman, Richard. 2020. Atlantic horseshoe crabs and endotoxin testing: Perspectives on alternatives, sustainable methods, and the 3rs (replacement, reduction, and refinement). *Frontiers in Marine Science* 7: 582132.

Gradmann, C., and J. Simon. 2010. *Evaluating and standardizing therapeutic agents, 1890–1950*. New York: Palgrave Macmillan.

Haraway, Donna. 1990. *Primate visions: Gender, race, and nature in the world of modern science*. New York: Routledge.

Haraway, D. 2012. Value-added dogs and lively capital. In *Lively capital biotechnolgies, ethics, and governance in global markets*, ed. Kaushik Sunder Rajan, 93–120. New York: Duke University Press.

Houdart, S. 2008. *La cour des miracles: Ethnologie d'un laboratoire japonais*. Paris: CNRS Editions.

Kirk, R.G.W. 2008. 'Wanted—standard guinea pigs': standardisation and the experimental animal market in Britain ca. 1919–1947. *Studies in History and Philosophy of Science* 39: 280–291.

Kirk, R.G.W. 2019. The experimental animal. In search of a moral ecology of science? In *The Routledge companion to animal–human history*, ed. Hilda Kean and Philip Howell, 121–146. London: Routledge.

Kirk, Robert G.W., Neil Pemberton, and Thibaut Serviant-Fine. 2022. The birth of hirudiculture: Parisian medicine, leech farming and the transformation of marshland in nineteenth-century France, *Environmental History*.

Kirk, R.G.W., and Michael Worboys. 2011. Medicine and species: One medicine, one history? In *The Oxford handbook of the history of medicine*, ed. Mark Jackson. Oxford: Oxford University Press.

Kohler, R.E. 1994. *Lords of the fly: Drosophila genetics and the experimental life*. Chicago: University of Chicago Press.

Logan, C.A. 2002. Before there were standards: The role of test animals in the production of empirical generality in physiology. *Journal of the History of Biology* 35: 329–363.

Maggs, H.C., A. Ainslie, and R.M. Bennett. 2021. Donkey ownership provides a range of income benefits to the livelihoods of rural households in northern Ghana. *Animals* 11: 3154. https://doi.org/10.3390/ani11113154.

Maigari, M.A., U. Dantani, M.M. Yelwa, and A. Ibrahim. 2020. Scavenging for Ejiao's raw material and the extinction of donkeys in Nigeria. *Global Journal of Sociology Current Issues* 10 (2): 71–87. https://doi.org/10.18844/gjs.v10i2.5102.

Matlhola, Dimpho Malebogo, and Ruishan Chen. 2020. Telecoupling of the trade of donkey-hides between Botswana and China: Challenges and Opportunities. *Sustainability* 12 (5): 1730.https://doi.org/10.3390/su12051730.

Marvin, G., and S. McHugh. 2014. Introduction. In *Routledge handbook of human–animal studies*, ed. Garry Marvin and Susan McHugh. London: Routledge.

Mitchell, P. 2018. *The donkey in human history: An archaeological perspective*. Oxford: Oxford University Press.

Nichter, M. 1996. [1989]), Pharmaceuticals, the commodification of health, and the health care-medicine use transition. In *Anthropology and international health: Asian case studies*, ed. M. Nichter and M. Nichter, 265–326. Amsterdam: Gordon and Breach Publishers.

Norris, S.L., H.A. Little, J. Ryding, and Z. Raw. 2021. Global donkey and mule populations: Figures and trends. *PLoS ONE* 16 (2): e0247830. https://doi.org/10.1371/journal.pone.0247830.

OECD, FAO. 2021. *OECD-FAO Agricultural Outlook 2021–2029*. Paris: FAO, Rome/OECD Publishing.

Olmer, Fabienne. 2009. La médecine dans l'Antiquité: Professionnels et pratiques. *Sociétés & Représentations* 2 (28): 153–172.

Pordié, Laurent, and Jean-Paul. Gaudillière. 2014. The reformulation regime in drug discovery: Revisiting polyherbals and property rights in the ayurvedic industry. *East Asian Science, Technology and Society: An International Journal* 8: 57–79.

Quet, Mathieu. 2021. *Illicit medicines in the global south. Public Health access and pharmaceutical regulation*. London: Routledge.

Rader, Karen. 2001. The Mouse's Tale: Standardized Animals in the Culture and Practice of Technoscience, Cabinet Magazine, 4, on line https://www.cabinetmagazine.org/issues/4/rader.php

Respess, Amanda, and Lisa C. Niziolek. 2016. Exchanges and transformations in gendered medicine on the maritime silk road: Evidence from the thirteenth-century Java Sea Wreck. In *Histories of medicine and healing in the Indian Ocean world the medieval and early modern period*, vol. One, ed. Anna Winterbottom and Facil Tesfaye, 63–97. London: Palgrave Macmillan.

Simon, Jonathan. 2008. Monitoring the stable at the Pasteur Institute. *Science in Context* 21 (2): 181–200.

Simon, Jonathan. 2016. *Diphtheria serum as a technological object. A philosophical analysis of serotherapy in France 1894–1900*. Lanham, MD: Lexington Books.

Skippen, L., J. Collier, and J.M. Kithuka. 2021. The donkey skin trade: A growing global problem. *Brazilian Journal of Veterinary Research and Animal Science* 58: e175262. https://doi.org/10.11606/issn.1678-4456.bjvras.2021.175262.

Still, J. 2003. Use of animal products in traditional chinese medicine: Environmental impact and health hazards. *Complementary Therapies in Medicine* 11 (2): 118–122. https://doi.org/10.1016/S0965-2299(03)00055-4.

Tansey, E.M. 1994. Protection against dog distemper and dogs protection bills: The medical research council and anti-vivisectionist protest, 1911–1933. *Medical History* 38: 1–26.

Tatemoto, P., Y.F. Lima, E. Santurtun, E.K. Reeves, and Z. Raw. 2021. Donkey skin trade: Is it sustainable to slaughter donkeys for their skin? *Brazilian Journal of Veterinary Research and Animal Science* 58: e174252. https://doi.org/10.11606/issn.1678-4456.bjvras.2021.174252.

Taylor, K., and L.R. Alvarez. 2019. An estimate of the number of animals used for scientific purposes worldwide in 2015. *Alternatives to Laboratory Animals* 47 (5–6): 196–213. https://doi.org/10.1177/0261192919899853.

Tsing, Anna. 2012. Unruly Edges: Mushrooms as companion species: For Donna Haraway. *Environmental Humanities* 1 (1): 141–154. https://doi.org/10.1215/22011919-3610012.

Tsing, Anna L. 2015. *The mushroom at the end of the World. On the possibility of life in capitalist ruins*. Princeton: Princeton University Press.

Tsing, Anna L., A.S. Mathews, and N. Bubandt. 2019. Patchy Anthropocene: Landscape structure, multispecies history, and the retooling of anthropology: An introduction to supplement 20. *Current Anthropology* 60: 186–197.

Tsing, Anna L., Jennifer Deger, Alder Keleman Saxena, and Feifei Zhou. 2020. *Feral Atlas. The more-than-human Anthropocene*. Redwood City: Stanford University Press.

Tsing, Anna L. 2021. Feral Atlas: the more-than-human Anthropocene—interview with Michael G. Vann. New Books in Science, Technology, and Society. Podcast.

Von Schwerin, A., H. Stoff, and B. Wahrig, eds. 2013. *Biologics, A history of agents made from living organisms in the twentieth century*. London: Pickering & Chatto.

Woods, Abigail. 2019. Animals in the history of human and veterinary medicine 147–170. In *The Routledge companion to animal–human history*, ed. Hilda Kean and Philip Howell. London: Routledge.

Other references and empirical sources

Addis. 2017. Donkey Abattoir Still in Business Despite Ban. Addis Fortune (Ethiopia). April 23, 2017. https://nouveau-europresse-com.ezproxy.u-paris.fr/Link/UNIVPARIS/news%c2%b720170423%c2%b7SADD%c2%b7494932782 accessed 25 March 2021.

AFP. 2019. Activists urge government to halt 'horrific' donkey skin sales to China. Agence France Presse, Daily Nation (Kenya). May 16, 2019. https://nouveau-europresse-com.ezproxy.u-paris.fr/Link/UNIVPARIS/news%c2%b720190516%c2%b7SDAY%c2%b7585670488. accessed 25 March 2021

Berhane, Samson. 2017. Donkey Meat Up for Export, Slaughterhouse Opens. Addis Fortune (Ethiopia). April 2, 2017. https://nouveau-europresse-com.ezproxy.u-paris.fr/Link/UNIVPARIS/news%c2%b720170402%c2%b7SADD%c2%b7493000439. https://addisfortune.net/articles/donkey-meat-up-for-export-slaughterhouse-opens/

Binda, Kristen. 2019. Domestic labourer or export product? Special report on the impact of the donkey skin trade. Donkeys for Africa, Issue 14. http://www.donkeysforafrica.org/Resources/DfA_July_2019_Newsletter.pdf

Brooke. Invisible workers. 2015. https://www.thebrooke.org/research-evidence/invisible-workers-economic-contribution-working-equids-livelihoods

Callick, Rowan. 2020. « China has been using the WHO as a key propaganda tool to influence the West ». The Australian. April 17, 2020. https://www.theaustralian.com.au/inquirer/china-has-been-using-the-who-as-a-key-propaganda-tool-to-influence-the-west/news-story/56c401f84cb589b345452857437aa6f4.

Cheung, H., H. Doughty, A. Hinsley, et al. 2021. Understanding traditional Chinese Medicine to strengthen conservation outcomes. *People Nature* 3: 115–128. https://doi.org/10.1002/pan3.10166.

Collins, Michael. 2020. « Traditional Chinese Medicine: A Cure for China's Soft Power Woes? » Council on Foreign Relations. 8 juin 2020. https://www.cfr.org/blog/traditional-chinese-medicine-cure-chinas-soft-power-woes.

Conrad, Emily. 2019. « The Donkey Hide Cure-All A potent traditional Chinese remedy is leading to a worldwide donkey shortage », 08 2019. https://www.theworldofchinese.com/2019/05/history-of-the-donkey-hide-cure-all/.

Cyranoski, David. 2018. Why Chinese Medicine Is Heading for Clinics around the World. *Nature* 561 (7724): 448–450. https://doi.org/10.1038/d41586-018-06782-7.

Daily Nation. 2019. China's huge appetite for donkey hide wiping out beast of burden. March 30, 2019. The Daily Nation. Kenya.

DEEJ. 2019. « The 13th Dongzhi Ejiao Festival Held in Dong'e County, Shandong Province ». Dong-E.-E.-Jiao Co. Ltd. December 26, 2019. https://www.prnewswire.com/news-releases/the-13th-dongzhi-ejiao-festival-held-in-donge-county-shandong-province-300979371.html.

Han, Liwen, Haotian Kong, Fasheng Liu, Xiaobin Li, Shanshan Zhang, Xuanming Zhang, Yong Wu, Hua Yang, Aiping Zhang, et Kechun Liu. 2019. « Protective Effect and Mechanisms of New Gelatin on Chemotherapy-Induced Hematopoietic Injury Zebrafish Model ». Research Article. Evidence-Based Complementary and Alternative Medicine. Hindawi. 21 août 2019. https://doi.org/10.1155/2019/8918943.

Humane Society International. 2018. « Ejiao: the production, raw material resources and consumption of donkey-hide gelatin - An investigative report prepared for Humane Society International », https://hsi.org.au/uploads/publication_documents/HSI_DHG_Investigation_WEB_AUST.pdf.

Li, Hao, Mei-juan Huang, Shao-quan Zhang, Ming-yu Ye, and Ping-fan Rao. 2006. Major constituent proteins in donkey hide and their interaction. *Zhongguo Zhong Yao Za Zhi = Zhongguo Zhongyao Zazhi = China Journal of Chinese Materia Medica* 31 (8): 659–663.

Li, Jennifer. 2016. « Donkey Skin Just the Tonic for China's Urbanites ». South China Morning Post. 24 juin 2016. https://www.scmp.com/business/companies/article/1980728/donkey-skin-just-tonic-chinas-urbanites.

Li, Wen-Long., Yan Zhang, Hai-Bin. Liu, Yin-Hong. Sun, Xiang-Shan. Zhou, and Qu. Hai-Bin. 2019a. Research progress on quality control methods of traditional Chinese medicine glues. *Zhongguo Zhong Yao Za Zhi = Zhongguo Zhongyao Zazhi = China Journal of Chinese Materia Medica* 44 (13): 2748–2752. https://doi.org/10.19540/j.cnki.cjcmm.20190321.306.

Li, Xue, Feng Shi, Liping Gong, Baojian Hang, Daoyuan Li, and Lianli Chi. 2017. Species-specific identification of collagen components in colla corii asini using a nano-liquid chromatography tandem

mass spectrometry proteomics approach. *International Journal of Nanomedicine* 12: 4443–4454. https://doi.org/10.2147/IJN.S136819.

Li, Yanfang, Hui He, Lilin Yang, Xiangyi Li, Daocheng Li, and Songping Luo. 2016. Therapeutic effect of colla corii asini on improving anemia and hemoglobin compositions in pregnant women with Thalassemia. *International Journal of Hematology* 104 (5): 559–565. https://doi.org/10.1007/s12185-016-2069-0.

Li, Yanfang, Zhanfeng Zhang, Lilin Yang, Xiangyi Li, Jingwen Zhou, Daocheng Li, and Songping Luo. 2019b. Colla corii asini might upregulate ZNF471 and THOC5 by KRAB domain-containing zinc-finger protein pathway and THO complex subunit 5 pathway to improve anemia of pregnant women with β-Thalassemia. *Annals of Hematology* 98 (8): 1813–1826. https://doi.org/10.1007/s00277-019-03710-1.

Lin, Annie Xianghong, Ging Chan, Hu. Yuanjia, Defang Ouyang, Carolina Oi Lam. Ung, Luwen Shi, and Hu. Hao. 2018. Internationalization of traditional Chinese medicine: current international market, internationalization challenges and prospective suggestions. *Chinese Medicine*. https://doi.org/10.1186/s13020-018-0167-z.

Liu, Maoxuan, Haining Tan, Xinke Zhang, Zhang Liu, Yanna Cheng, Dongliang Wang, and Fengshan Wang. 2014. Hematopoietic effects and mechanisms of Fufang E'jiao Jiang on radiotherapy and chemotherapy-induced myelosuppressed mice. *Journal of Ethnopharmacology* 152 (3): 575–584. https://doi.org/10.1016/j.jep.2014.02.012.

Liu, Rui, Luyao Zhao, Zhiying Wang, Tong Li, Ailiang Chen, and Shuming Yang. 2020. Quantitative detection of donkey hide gelatin (colla corii asini) adulteration by real-time PCR based on single-copy nuclear genes. *Journal of Food Protection, Août*. https://doi.org/10.4315/JFP-20-140.

Kimuyu, H. High Court allows slaughter, sale of donkey meat in Kenya. Nairobi News, May 6th, 2021. https://nairobinews.nation.co.ke/news/high-court-allows-slaughter-sale-of-donkey-meat-in-kenya

Ma, Ke., Xin Wang, Shiyao Feng, Xueshan Xia, Hongxiu Zhang, Abdul Rahaman, Zhenfei Dong, et al. 2020. From the perspective of traditional Chinese medicine: Treatment of mental disorders in COVID-19 survivors. *Biomedicine & Pharmacotherapy = Biomedecine & Pharmacotherapie* 132: 110810. https://doi.org/10.1016/j.biopha.2020.110810.

Maichomo, M. W., T. Karanja–Lumumba, M. O. Olum, J. Magero, T. Okech, and S.N. Nyoike. The status of donkey slaughter in Kenya and its implications on community livelihoods. The Brooke East Africa, April 2019. https://www.kalro.org/sites/default/files/donkey-kalro-report-final-trade-crisis.pdf

Marindany, Kurgat. 2020. « Donkeys will be extinct in Kenya by 2023 - ANAW ». The Star, January 24, 2020. https://www.the-star.co.ke/news/2020-01-24-donkeys-will-be-extinct-in-kenya-by-2023-anaw.

Master, Farah. 2019. « As China Pushes Traditional Medicine Globally, Illegal Wildlife Trade Flourishes ». *Reuters*, 28 mars 2019. https://www.reuters.com/article/us-china-tcm-idUSKCN1R90D5.

Mercury. 2017. Cruelty charges for 35 donkey deaths. The Mercury (South Africa). February 1, 2017. https://nouveau-europresse-com.ezproxy.u-paris.fr/Link/UNIVPARIS/news%c2%b720170201%c2%b7SMEY%c2%b7479567035. access 25 March 2021.

Micollier, Evelyne. 2015. Medical Ethics and Therapeutic Knowledge from China as Contested Knowledge in Times of Globalization. *Chiang Mai University Journal of Natural Sciences*. https://doi.org/10.12982/cmujASR.2015.0006.

Murage, George. 2017. Uganda saves donkeys, outlaws trade, slaughter. The Star (Nairobi, Kenya). August 29, 2017. https://nouveau-europresse-com.ezproxy.u-paris.fr/Link/UNIVPARIS/news%c2%b720170829%c2%b7GSADR%c2%b7502152738 accessed 25 March 2021. https://www.the-star.co.ke/news/2017-08-29-uganda-saves-donkeys-outlaws-trade-slaughter/

Mwangi, Macharia, and George Sayagie. 2017. Donkey slaughterhouses blamed for drop in numbers. Daily Nation (Kenya), September 11, 2017. https://nouveau-europresse-com.ezproxy.u-paris.fr/Link/UNIVPARIS/news%c2%b720170911%c2%b7SDAY%c2%b7504111841. accessed 25 March 2021. https://allafrica.com/stories/201709110474.html

Nampa. 2017. Minister of economics and national planning expressed her support. The Namibia Press Agency (Nampa). March 20, 2017. https://nouveau-europresse-com.ezproxy.u-paris.fr/Link/UNIVPARIS/news%c2%b720170320%c2%b7ANAM%c2%b7010. accessed 25 March 2021.

Nation. 2019. 'No feud among Customs chiefs'. The Nation (Nigeria). April 16, 2019. https://nouveau-europresse-com.ezproxy.u-paris.fr/Link/UNIVPARIS/news%c2%b720190416%c2%b7ANAG%c2%b7027. accessed 25 March 2021. https://thenationonlineng.net/no-feud-among-customs-chiefs/

Nation. (2018). Bill proposes 10 years jail for killing, exporting donkey. The Nation (Nigeria). November 14, 2018. https://nouveau-europresse-com.ezproxy.u-paris.fr/Link/UNIVPARIS/news%c2%b720181114%c2%b7ANAG%c2%b7046. accessed 25 March 2021.

Ngotho, Agatha. 2020. Donkey prices up by Sh10,000 after ban on slaughter and meat export. The Star (Nairobi, Kenya). September 8, 2020. Consulted at: https://nouveau-europresse-com.ezproxy.u-paris.fr/Link/UNIVPARIS/news%c2%b720200908%c2%b7GSADR%c2%b7634872787. accessed 25 March 2021. https://www.the-star.co.ke/news/2020-09-08-donkey-prices-up-by-sh10000-after-ban-on-slaughter-and-meat-export/

Obi, Leopold. 2019a. China's huge appetite for donkey hide wiping out beast of burden. Daily Nation (Kenya), March 30, 2019. https://nouveau-europresse-com.ezproxy.u-paris.fr/Link/UNIVPARIS/news%c2%b720190330%c2%b7SDAY%c2%b7580576304. accessed 25 March 2021. https://wardheernews.com/chinas-huge-appetite-for-donkey-hide-wiping-out-beast-of-burden/

Obi, Leopold. 2019b. China's huge appetite for donkey hide wiping out beast of burden. Nation, March 30, 2019. Available at: https://nation.africa/kenya/news/china-s-huge-appetite-for-donkey-hide-wiping-out-beast-of-burden-153212. accessed 7 Dec 2022.

Procopio, Maddalena. 2020. « China and Africa: the "power" of traditional medicine ». A-id: Agenda for International Development (blog). 25 septembre 2020. https://www.a-id.org/2020/09/25/china-and-africa-the-power-of-traditional-medicine/.

Editors, S.A. 2019. « The World Health Organization Gives the Nod to Traditional Chinese Medicine. Bad Idea ». Scientific American. April 1st 2019. https://doi.org/10.1038/scientificamerican0419-6.

Shen, Lijuan, Houliu Chen, Qiufang Zhu, Yongyi Wang, Saisai Wang, Jing Qian, Yi. Wang, and Qu. Haibin. 2016. Identification of Bioactive Ingredients with Immuno-Enhancement and Anti-Oxidative Effects from Fufang-Ejiao-Syrup by LC–MSn Combined with Bioassays. *Journal of Pharmaceutical and Biomedical Analysis* 117: 363–371. https://doi.org/10.1016/j.jpba.2015.09.024.

Sheu, Shyang-Chwen., Jhong-Yong. Huang, Yi-Yang. Lien, and Meng-Shiou. Lee. 2020. Specific, sensitive and rapid authentication of donkey-hide gelatine (colla corii asini) in processed food using an isothermal nucleic acid amplification assay. *Journal of Food Science and Technology* 57 (8): 2877–2883.

Sun, Ting, Shiying Li, Xiaoting Xia, Chuanliang Ji, Shanyi Shen, Guoliang Zhang, Yu. Jie, Guimiao Jiang, Ruihua Dang, and Chuzhao Lei. 2017. ASIP gene variation in Chinese donkeys. *Animal Genetics* 48 (3): 372–373. https://doi.org/10.1111/age.12530.

Thatayamodimo, Lesedi. 2017. Agric show grows in leaps, bounds. Botswana Daily News, August 16, 2017. https://nouveau-europresse-com.ezproxy.u-paris.fr/Link/UNIVPARIS/news%c2%b720170816%c2%b7SBOT%c2%b7500826909. accessed 25 March 2021. http://www.dailynews.gov.bw/news-details.php?nid=37912.

The Donkey Sanctuary. 2017. « Under the skin: The emerging trade in donkey skins and its implications for donkey welfare and livelihoods. » https://www.thedonkeysanctuary.org.uk/sites/uk/files/2017-11/under_the_skin_report.pdf.

The Donkey Sanctuary. 2019. Under the skin: Update on the global crisis for donkeys and the people who depend on them. Available at:https://www.thedonkeysanctuary.org.uk/sites/uk/files/2019-12/under-the-skin-report-englishrevised-2019.pdf.

The Donkey Sanctuary. 2019. Under the skin: Update on the global crisis for donkeys and the people who depend on them. https://www.thedonkeysanctuary.org.uk/sites/uk/files/2019-12/under-the-skin-report-english-revised-2019.pdf

Wang, Dongliang, Ru. Wenwen, Xu. Yunpeng, Jianling Zhang, Xianxian He, Guohua Fan, Beibei Mao, Xiangshan Zhou, and Yufeng Qin. 2014. Chemical constituents and bioactivities of colla corii asini. *Drug Discoveries & Therapeutics* 8 (5): 201–207. https://doi.org/10.5582/ddt.2014.01038.

Wen, Xin. 2018. Experts cast doubts on product's beneficial effects. China Daily, March 28, 2018. https://www.chinadaily.com.cn/a/201803/28/WS5abaeaf8a3105cdcf6514ba9.html.

Wu, Hongzhong, Chunyan Ren, Fang Yang, Yufeng Qin, Yuanxing Zhang, and Jianwen Liu. 2016. Extraction and identification of collagen-derived peptides with hematopoietic activity from colla corii asini. *Journal of Ethnopharmacology* 182: 129–136. https://doi.org/10.1016/j.jep.2016.02.019.

Wyatt Design Group. 2017. Dong-e E-Jiao Bio Tech Park. Consulté le 2 février 2021. https://wyattdesigngroup.com/portfolio/dong-e-e-jiao-biotech-park-china/.

Xiao, Li., Feng Liao, Yumei Fan, and Nobuhiko Miwa. 2020a. Enzyme-digested colla corii asini (e'jiao) accelerates wound healing and prevents ultraviolet a-induced collagen synthesis decline and wrinkle formation in three-dimensional skin equivalents. *Human Cell* 33 (4): 1056–1067. https://doi.org/10.1007/s13577-020-00405-y.

Xiao, Li., Feng Liao, Ryoji Ide, Tetsuro Horie, Yumei Fan, Chikako Saiki, and Nobuhiko Miwa. 2020b. Enzyme-digested colla corii asini (e'jiao) prevents hydrogen peroxide-induced cell death and accelerates amyloid beta clearance in neuronal-like PC12 cells. *Neural Regeneration Research* 15 (12): 2270–2272. https://doi.org/10.4103/1673-5374.285000.

Xinhua. 2016. Shortage of donkey skin breeds TCM fakes. January 28, 2016. Xinhua News Agency. https://nouveau-europresse-com.ezproxy.u-paris.fr/Link/UNIVPARIS/news%c2%b720160128%c2%b7XN%c2%b7xxjwshe000030_20160128_bjtfn0_simple. accessed 25 March 2021 http://www.china.org.cn/china/2016-01/28/content_37683769.htm

Xu, Hai-Yu., Song-Song. Wang, Hong-Jun. Yang, Bao-Lin. Bian, Shou-Sheng. Tian, Dong-Liang. Wang, Lu. Peng, Xiang-Shan. Zhou, Jin-Hua. You, and Lu.-Qi. Huang. 2014. Study on action mechanism of adjuvant therapeutic effect compound Ejiao slurry in treating cancers based on network pharmacology. *Zhongguo Zhong Yao Za Zhi = Zhongguo Zhongyao Zazhi = China Journal of Chinese Materia Medica* 39 (16): 3148–3151.

Xu, Xiaobing, Shangwei Guo, Xianghui Hao, Hui Ma, Yanping Bai, and Yaqin Huang. 2018. Improving antioxidant and antiproliferative activities of colla corii asini hydrolysates using ginkgo biloba extracts. *Food Science & Nutrition* 6 (4): 765–772. https://doi.org/10.1002/fsn3.587.

Yao, D.F., Y.F. Zhang, and Y.F. Zhou. 1989. Effects of Ejiao (colla corii asini) on the hemodynamics, hemorheology and microcirculation during endotoxin shock in dogs. *Zhongguo Zhong Yao Za Zhi = Zhongguo Zhongyao Zazhi = China Journal of Chinese Materia Medica* 14 (1): 44–46.

Zhang, Shan, Xu. Lu, Yang-Xi. Liu, Fu. Hai-Yan, Zuo-Bing. Xiao, and Yuan-Bin. She. 2018. Characterization of aroma-active components and antioxidant activity analysis of e-jiao (colla corii asini) from different geographical origins. *Natural Products and Bioprospecting* 8 (2): 71–82. https://doi.org/10.1007/s13659-017-0149-3.

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