

The Application of *al-Intiqal* (the transition) on Synthetically Modified Organisms (SMOs): An Analysis from Shariah and Science Approaches

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Abstract

Synthetic biology, or SynBio, is a fast-growing technology, that combines biology, chemistry, computer science, and engineering, producing synthetically modified organisms (SMOs), in which organisms for which a large part or the entire genome has been designed using computer-aided design tool and chemically synthesized. Concern arises when (*deoxyribonucleic acid*) DNA constructs are made up of impure (*najs*) substances in Shariah as raw material, like transfer of engineered pig cells with modified genomes. One of alternative verification methods of Shariah law, namely *al-Intiqal* (the transition), can assist Muslim jurists in determining legal rulings on particular Halal contemporary issues, as there is no explicit information about genetic modified technology in the Qur'an or Hadith. This study aims to determine the theory of *al-Intiqal* (the transition) from Shariah and science approaches and apply the structure and division of *al-Intiqal* (the transition) on SMOs productions, like synthetic spider silk and humanized pig organ. Qualitative methods were applied including library research, fiqh adaptation (*al-takyif al-fiqhi*), and semi structured in-depth interview. Study shows that two divisions of *al-Intiqal* (the transition) can be applied within SMOs productions, which are *al-Intiqal al-sabih* (the accepted transition) and *al-Intiqal al-fasid* (the damaged transition). Study concludes that DNA synthesizer as conversion agent within SMOs production process can be considered permissible (Halal), while synthetic spider silk is also permissible (Halal) as the raw material is considered pure and its transition process had completely occurred in Shariah, nonetheless humanized pig organ is impermissible (Haram) as the raw material and its recipient organism are impermissible (Haram) and its transition process had not completely occurred in Shariah, except for emergency (*darurah*) case with some provisions.

Keywords: *Al-Intiqal*, Synthetic Biology, Synthetically Modified Organisms, Halal.

1.0 INTRODUCTION

Along with the advancement of science and technology, new methods are utilized within the production process with a variety of ingredients, and hence challenges may arise in determining its Halal status (Salahudin et al., 2017). In ascertaining the status of genetic modified products, determinations of Halal must be supported by other considerations because there is no straightforward information concerning genetic modified technology in the Qur'an or Hadith (Idris et al., 2020). In fact, scientists now can generate organisms with whole new gene clusters (Garthwaite, 2014), and hence they can design completely novel proteins that self-assemble into predicted shapes using computational methods (Ljubetic et al., 2017) producing synthetically modified organisms (SMOs), in which organisms for which a large part or the entire genome has been designed using a computer-aided design tool and chemically synthesized (Randall & Andrew, 2017). Concern occurs when (*deoxyribonucleic acid*) DNA constructs are made up of impure (*najis*) substances in Shariah as raw material, like transfer of engineered pig cells with modified genomes. One of the alternative verification methods of Shariah law, namely *al-Intiqal* (the transition), can help Muslim jurists in determining legal rulings on some Halal contemporary issues. In Shariah, *al-Intiqal* can be described as a transferring process from one state to another, or from one place to another, and this transferring process gives impact towards the status of the end product, either permissible (Halal) or impermissible (Haram) (Jamaludin et al., 2012).

The objectives of this study are to determine the theory of *al-Intiqal* (the transition) from Shariah and science approaches and apply the structure and division of *al-Intiqal* (the transition) on SMOs productions, which are synthetic spider silk and humanized pig organ. Qualitative approaches have been applied including library research, fiqh adaptation (*al-takyif al-fiqhi*), and semi structured in-depth interview. Study reveals that two divisions of *al-Intiqal* (the transition) can be applied within SMOs productions, which are *al-Intiqal al-sahib* (the accepted transition) and *al-Intiqal al-fasid* (the damaged transition). Study concludes that DNA synthesizer as conversion agent within SMOs production process can be considered permissible (Halal), while synthetic spider silk is also permissible (Halal) as the raw material is considered pure and its transition process had completely occurred in Shariah, nonetheless humanized pig organ is impermissible (Haram) as the raw material and its recipient organism are impermissible (Haram) and its transition process had not completely occurred in Shariah, except for emergency (*darurah*) circumstance with some requirements.

2.0 LITERATURE REVIEW

2.1 Concept of *al-Intiqal* in Shariah Law

Etymologically, the term *al-Intiqal* is derived from the Arabic root word *na-qa-la* (نقل), which means “transfer”, “transmit”, “transit”, or “change” (Almaany, 2010). Qal’ahji (1985) in his masterpiece, “*Mu’jam Lughah al-Fuqaha*”, defined *al-Intiqal* literally as the transition or translocation. In technical approach, Qal’ahji (1985) defined *al-Intiqal* as a change from one state to another, or a translocation from one place to another, or a transition from one thought to another, or from one school of Islamic jurisprudence (*maẓhab*) to another. Besides, *al-Intiqal* can be described as a transferring process from one state to another, or from one place to another, and this transferring process gives impact towards the status of the end product, either permissible (Halal) or impermissible (Haram) (Jamaludin et al., 2012). The place of *al-Intiqal* under Shariah law is similar to *al-Istihalah* (the transformation), as alternative verification method.

In Halal research area, *al-Intiqal* can be divided into three categories, which are *al-Intiqal al-sahib* (the accepted transition), *al-Intiqal al-fasid* (the damaged transition), and *al-Intiqal al-batil* (the

nullified transition). *Al-Intiqal al-sahib* also refers to the accepted or valid transition process because the end product is Halal and pure (*tabir*), even the raw material or the conversion agent is initially considered *najs* (impure) or *mutanajjis* (contaminated with *najs*). Secondly, *al-Intiqal al-fasid* refers to the damaged transition process, as such the transition process occurred from the raw material to the end product, nonetheless the end product is considered impermissible (Haram) (Jamaludin et al., 2012). Usually, for *al-Intiqal al-fasid* (the damaged transition), the raw material which is permissible (Halal) is mixed with impermissible (Haram) conversion agent, or the raw material which is impermissible (Haram) is mixed with permissible (Halal) conversion agent, producing an impermissible (Haram) end product. Thirdly, *al-Intiqal al-batil* is the nullified transition. In this case, the raw material is usually from impure (*najs*) thing and is mixed with the impure (*najs*) conversion agent, which then will create an impure (*najs*) end product too, having said that, the transition process in this case is nullified by Shariah. Basically, in Halal research area, the structure of *al-Intiqal* (the transition) comprises three main components, which are the raw material, the conversion agent, and the end product, in which the raw material will undergo transition process to the end product via the conversion agent, either naturally or synthetically, for which the end product will be different, either physically or chemically, from the raw material (Jamaludin et al., 2012). The structure of *al-Intiqal* (the transition) can be observed in Figure 1. In Islamic jurisprudence, *al-Istihalah* (the transformation) is the general term for all transformations that occurred within the scope of Halal and Haram issues, whereby *al-Intiqal* (the transition) is the specific term to be used within the scope of Halal and Haram in the biotechnology processing, and both of these methods have similar structure.

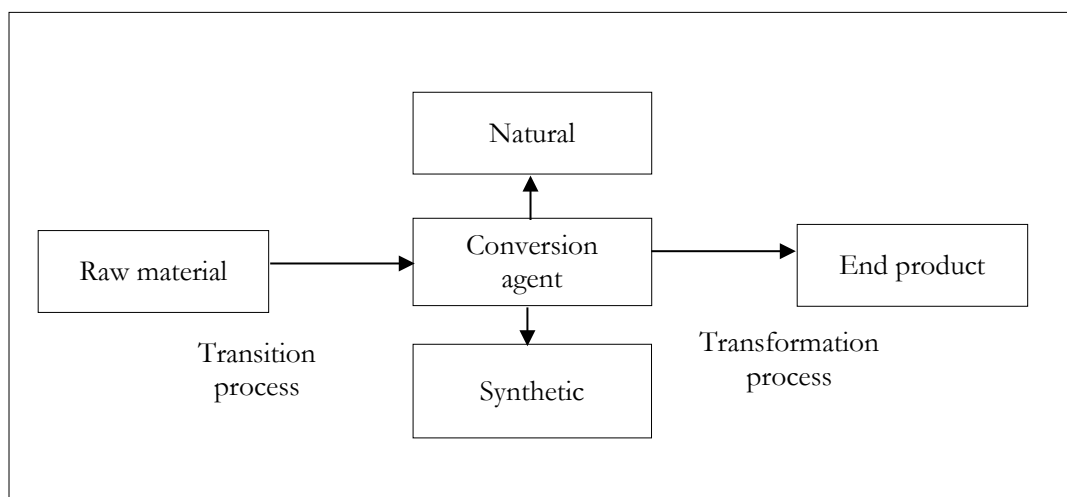


Figure 1: The structure of *al-Intiqal* (the transition) (Jamaludin et al., 2012)

2.2 Production Process of Synthetically Modified Organisms (SMOs)

Synthetic biology is a branch of study that blends biology, chemistry, computer science, and engineering to produce biological systems with abilities that are not present in nature (Carter & Manley, 2020), and it can be defined as repurposing biological systems to handle a particular task with a user-defined goal, such as antibody manufacturing, as well as developing innovative bioremediation process (National Human Genome Research Institute, 2019). Besides, synthetically modified organisms (SMOs) are creatures for which a major part of the genome or the whole genome has been engineered using a computer-aided design software and chemically synthesized (Randall & Andrew, 2017).

The advancement of this novel technology is described as a basic engineering “design, build, test, and learn” (DBTL) series (National Academies of Sciences, Engineering, and Medicine, 2018). The concept is founded on the premise that DNA sequences may be utilized as building blocks to create a living entity with any desired combination of traits, as well as to introduce or edit a single gene on a more complex degree, basically creating an organism’s genome from scratch (Carter & Manley, 2020). These DNA components are then synthesized from a collection of overlapping single-stranded oligonucleotides (synthons), assembled and combined into larger pieces of DNA, cloned into an expression vector, the sequence of the resultant construct is then verified and transformed into a cell, and tested for functional motive, with more iterations of the test series repeated until the desired function is achieved (Randall & Andrew, 2017). Figure 2 depicts a brief sketch of the production process of genetically modified organisms (GMOs) and synthetically modified organisms (SMOs) and their Halal critical points. Gene X is the raw material and the protein at the end process is the finished product in these production processes, and both of these are the Halal critical points in GMOs and SMOs production. The distinction between GMOs and SMOs is that the scientist extracts the genes from a living organism in creating GMOs, whereas the scientist designs the desired gene using computer-aided design tools and then chemically synthesizes the genes in order to create SMOs.

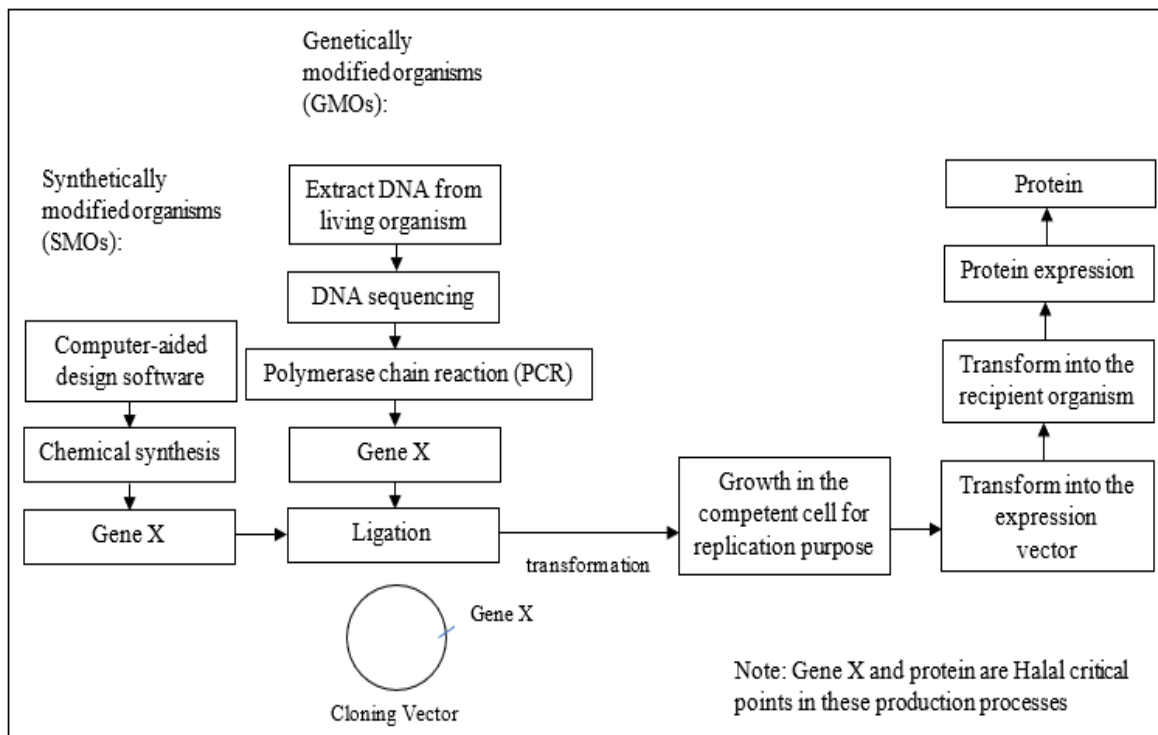


Figure 2: A brief sketch of the production process of genetically modified organisms (GMOs) and synthetically modified organisms (SMOs) and their Halal critical points

3.0 METHODOLOGY

Firstly, the data were collected using library research from both antecedent and contemporary evidences from Muslim jurists and scholars, as well as the scientists. Next, fiqh adaptation (*al-takyif al-fiqhi*) is applied, in which to link the laws that have been determined by previous scholars to be discussed in the similar scope, and hence it has been applied in Islamic research methodology as alternative to conventional literature review (Khairuldin et al., 2020). In this study, the researchers adapted the previous legal rulings on clothes made up of silk, for instance from silkworm yarn, to be applied on spider silk production, and adapted the previous legal rulings on organ and tissue

donation and the usage of impure (*najis*) materials, such as pig, as a medication purpose, from Muslim jurists and various *fatwa* institutions, to be applied on humanized pig organ production. Besides, semi structured in-depth interview is applied, in which the informants that have been identified are based on their credibility according to the subject of research interest, and hence six experts from Shariah law and biotechnology backgrounds have been interviewed by the researchers.

4.0 RESULTS AND DISCUSSION

4.1 Application of *al-Intiqal* on Synthetically Modified Organisms (SMOs) from Halal Perspective

4.1.1 Synthetic Spider Silk Production

The first stride in producing synthetic or recombinant spider silk is to recognize novel spider silk sequences using computational and bioinformatics methods, and a thorough understanding of spider sequences from various silk types and species is required to form a link between various spider species evolution and the mechanical elements of their silk fibres (Poddar et al., 2020). A particular catalogue comprises the full set of spidroin genes for the orb-weaving spider *Aranenus ventricosus* was carefully curated in Kono et al. (2019) research experiment, resulting in the discovery of several novel sequences (Poddar et al., 2020), having said that, the primary step is the design and synthesis of desired gene segments (known as spidroin sequences) guided by computational approaches (Teule et al., 2009).

The Moon Parka, the world's first outerwear jacket made from microbially-produced protein materials, was released in 2019 as a result of a collaboration between The North Face and Spiber's Technologies, in which at Spiber, synthetic spider silk production began with the designation of the genes that code for the desired structural proteins (for example: the spidroin gene), and those genes were then introduced into microorganisms like *Escherichia coli*, which are engineered to produce the protein in a highly productive manner (Spiber Inc., 2019). Moreover, the resulting sequence collections may be inserted into an appropriate expression vector and transformed into the host organism for recombinant expression and functional screening (Poddar et al., 2020). Other raw materials, like sugars and minerals are essential as a source of energy and nutrients for the microorganisms to make proteins, and these raw materials are then prepared within a large-scale vessel, the microorganisms are then engineered, grow and multiply, and the proteins are built at high efficiency via fermentation activity (Spiber Inc., 2019). The fibre spun with the native-sized recombinant spider silk protein exhibited mechanical qualities similar to native spider silk, suggesting a wide variety of industrial and medicinal uses (Xia et al., 2010). Following fermentation, the purification process begins, in which proteins are isolated from the microbes themselves, the purified proteins are then dried, and the resultant powder is processed into a number of forms, like fibers and films (Spiber Inc., 2019).

In Shariah, silk is also mentioned in the Qur'an. Allah the Almighty says: "*Indeed, Allah will admit those who believe and do righteous deeds to gardens beneath which rivers flow. They will be adorned therein with bracelets of gold and pearl, and their garments therein will be silk*", (Qur'an, 22:23). Other than that, in the Hadith of the Prophet Muhammad (PBUH), 'Umar, Anas, Ibn az-Zubair, and Abu Umama reported the Prophet as saying: "*He who wears silk in this world will not wear it in the next*", (Bukhari and Muslim, Mishkat al-Masabih, Book 22, Hadith 13), and it was narrated from 'Umar, who said: "*He did not allow the wearing of silk except (something) the width of four fingers*", (Sunan an-Nasa'i, Book 48, Hadith 274). Besides, it was narrated from Abu Musa that the Prophet Muhammad (PBUH) said:

“Gold and silk have been permitted for the females of my Ummah, and forbidden to the males”, (Sunan an-Nasa’i, Book 48, Hadith 109). All of the Hadith mentioned above were graded as authentic (sahih).

According to scientific research, spider silks have exceptional mechanical qualities that make them appealing for industrial and medicinal uses, in which all spiders can produce seven different types of silk, one to wrap its prey, one to wrap its eggs, and five to create the spider web (Benito, 2002). From Shariah standpoint, the popular view among the Islamic jurists (*fuqaha*) as expressed by Imam al-Subki and al-Adzra’i in *Fathul Mu’in*, is that the spider web is pure (*tahir*), hence when a person touches a spider web, then he does not have to purify himself because the spider web is considered pure (*tahir*) (Al-Malibari, 2004). Some contemporary jurists also said the similar opinion, in which, the spider web is pure (*tahir*), and the prayer (*salah*) is considered valid if one finds some dreads of spider web on his face after the prayer (Mufti Ebrahim Salejee, 2013), and this opinion is also held by Darul Iftaa (2011).

Basically, in Shariah, the ruling of men wearing clothes made up of 100% silk thread is impermissible (Haram), and it is also impermissible (Haram) for men to wear clothes blended with silk where the silk blend is more (over 50%) than other fabric materials, whereas it is permissible (Halal) for men to wear silk clothes if the silk blend and other materials are at the same percentage or the silk blend is less than 50%, and an exception is specified for little boys in wearing silk and facilitation (*rukhsah*) is granted to men on emergency (*darurah*) and dire need conditions, like skin disorders (Mufti of Federal Territory, 2020). In addition, synthetic silk is artificial silk that is not derived from silkworm yarn, and hence the rulings of its usage is permissible (Halal/ *mubah*) (Jawatankuasa Fatwa Negeri Pulau Pinang, 2018). Figure 3 depicts the process of *al-Intiqal al-sahih* (the accepted transition) in synthetic spider silk production in textile industry.

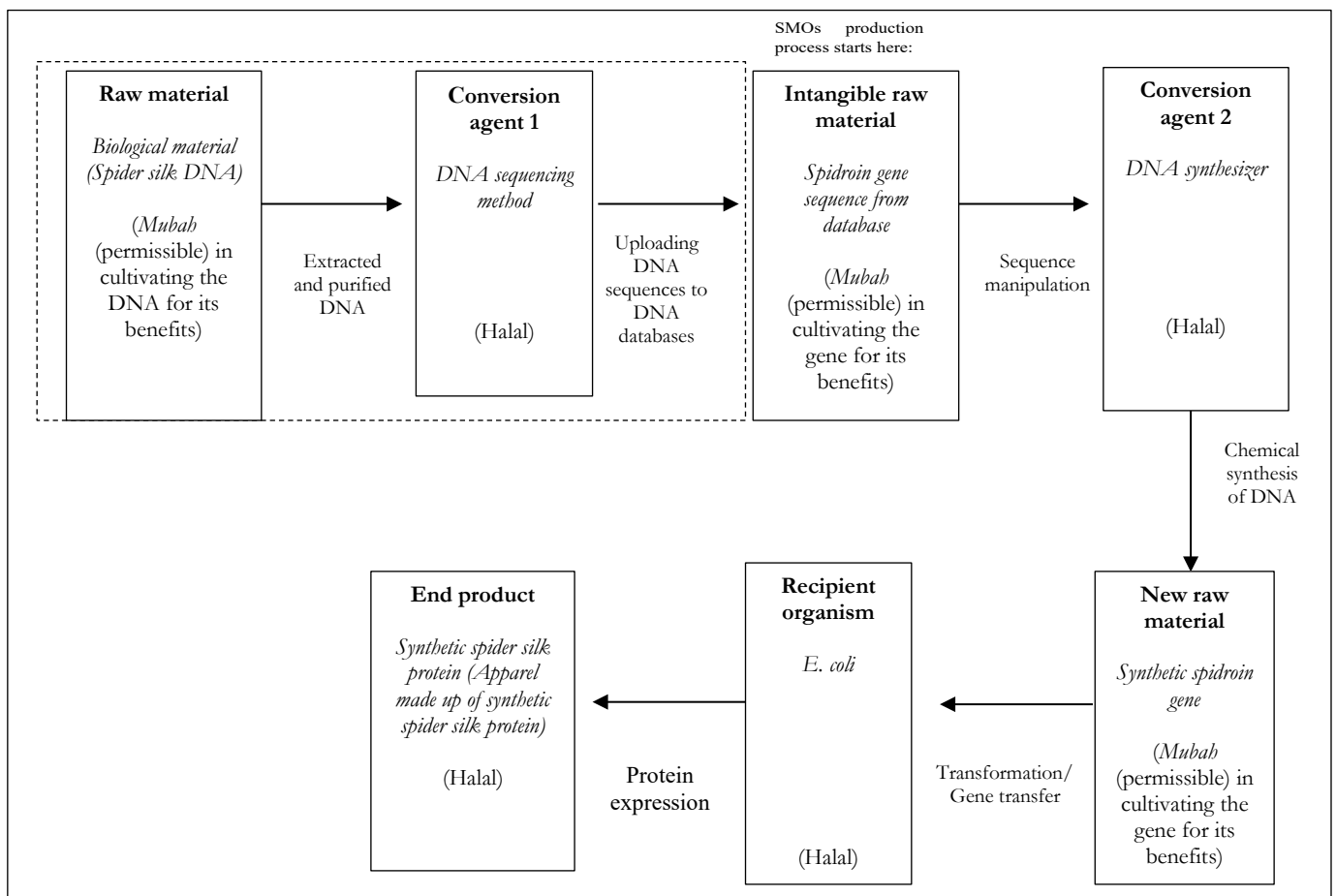


Figure 3 The Process of *al-Intiqal al-sahih* (the accepted transition) in Synthetic Spider Silk Production in Textile Industry. Box with dotted lines indicates processes not included in production of SMOs

4.1.2 Humanized Pig Organ Production

According to the Organ Procurement and Transplantation Network, there are presently over 110,000 patients on the organ transplant waiting list, yet the number of organs available through donation has remained relatively constant, and even a massive increase in organ donation would not guarantee that a compatible organ would be available when and where needed for a patient (Stevens, 2019). Scientific studies found that xenotransplantation may be a viable approach (Hryhorowicz et al., 2017), in which it is a technique that includes the transplantation, implantation, or infusion of living cells, tissues, or organs from non-human animal sources into a human recipient (Krishnasamy, 2007). Scientists are attempting to rewrite the pig genome using a synthetic biology approach in order for the animal to grow lungs that could be transplanted into a human body, having said that, they are re-engineering the pig, changing the genetic code on computers, building it in the lab, and implanting it into a cell which went on to reproduce (Steenhuysen, 2014). A human received a heart transplant for the first time from a pig that had been genetically engineered to increase its chances of acceptance in a human body, and the donated heart came from a pig evolved by the US firm Revivicor (Wilson, 2022). Because its anatomical and physiological features are similar to humans, the domestic pig (*Sus scrofa domestica*) was chosen as a donor of biological properties for this transplant (Hryhorowicz et al., 2017; Hryhorowicz et al., 2020). Overall, the animal had 10 genes engineered in a transplant process of a pig's heart into a human body, and four of those were inactivated, as well as one that causes an aggressive immune reaction and one that would otherwise cause the pig's heart to keep on growing after transplant, having said that, the donor pig had six human genes inserted into its genome to maximize the possibility of acceptance (Wilson, 2022).

Some Muslim scholars and fatwa institutions around the globe, including the Islamic Religious Council of Singapore, the Council of Senior Scholars Saudi Arabia, the Fatwa Council of Kuwait, Majma' al-Fiqh al-Islami, Majma' al-Fiqh al-Islami al-Hind, the Islamic Shariah Council United Kingdom, as well as Muzakarah Committee of the National Council for Islamic Religious Affairs Malaysia have ruled that organ donation is permissible (Halal/ lawful/ *mubah*) (Council of Senior Scholars, 1402H; Ebrahim, 2002; Islamic Religious Council of Singapore, 2007; Howitt, 2009; Albar, 2010; Mufti of Federal Territory, 2019). Al-Bakri (2021) has issued his opinion regarding organ and tissue donation, in which the legal rulings for organ and tissue donation is permissible (Halal) and highly encouraged, nonetheless it is impermissible (Haram) to perform testis or female uterus (womb) donation as both are closely related to hereditary lineage (Al-Bakri, 2021). As Allah the Almighty says: “*And cooperate in righteousness and piety, but do not cooperate in sin and aggression*”, (Qur'an, 5:2). On the other hand, in Shariah, the basic principle for organ transplants involving non-human to human recipient is that it is impermissible to use impure (*najis*) substance if there is pure (*tabir*) substance, while the impure (*najis*) substance can be consumed if there is an urgent need and there is no pure (*tabir*) source that can be used (Al-Bakri, 2021). The basis ruling of the prohibition of the pig is clear in Shariah, as Allah the Almighty says: “*He has only forbidden to you dead animals, blood, the flesh of swine, and that which has been dedicated to other than Allah. But whoever is forced [by necessity], neither desiring [it] nor transgressing [its limit], there is no sin upon him. Indeed, Allah is Forgiving and Merciful*”, (Qur'an, 2:173). Figure 4 below elucidates the process of *al-Intiqal al-fasid* (the damaged transition) in humanized pig organ production without an emergency (*darurah*) case.

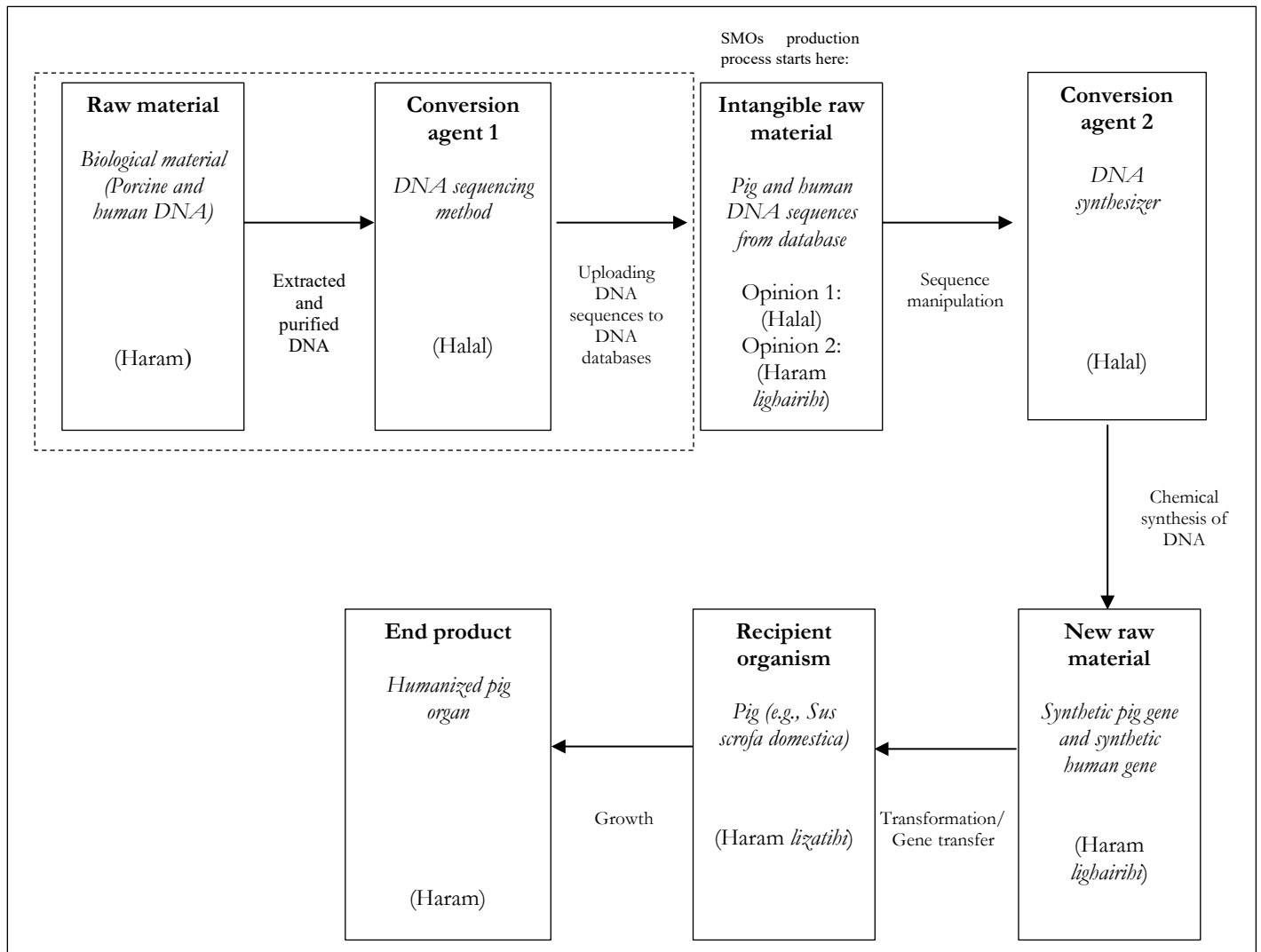


Figure 4 The Process of *al-Intiqal al-fasid* (the damaged transition) in Humanized Pig Organ Production without An Emergency (*darurah*) Case. Box with dotted lines indicates processes not included in production of SMOs.

The researcher agreed that the basis ruling for DNA sequences from database, synthetic material, and DNA synthesizer are permissible (Halal), and this fact is in accordance with the principle of *al-Istisbab* (the presumption of continuity) in Usul al-Fiqh, wherein in terms of etymological meaning, *al-Istisbab* means asking for togetherness, or continuing togetherness, while in terms of terminology, and there are numerous definitions about *al-Istisbab* that have been put by scholars (Maulidizen and Amar, 2018), in which Imam al-Shaukani in his masterpiece, *Iryad al-Fuhul*, described *al-Istisbab* as “a proposition that views a matter as long as nothing changes it”, in the sense that the provisions in the past, based on the original law, still hold true for the present and the future (Al-Shaukani, 1994), as well as the Islamic legal maxim once said:

“الأصل في الأشياء الإباحة حتى يدل الدليل على التحريم”

Meaning: “The norm in regard to things is that of permissibility until there is a clear prohibition against it”. Thus, the researcher is in the opinion that in determining the legal rulings for pig and human DNA sequences from database, it can be categorized into two major opinions, considering the principle of *al-Istisbab* (the presumption of continuity) and *sadd al-dhara’i* (the preventive measures) in Usul al-Fiqh, wherein: (1) the first opinion is that the pig and human DNA sequences from database are Halal (permissible) because these DNA sequences are not originally extracted from the real pig

and human themselves, and these DNA sequences are actually in the type of intangible materials, having said that, the pig and human DNA sequences from database are neither can be touched, nor having physical presence, and (2) the second opinion is that the pig and human DNA sequences from database are considered Haram *lighairibi* (prohibition due to the other thing) because of other prohibited factors, which are (i) these materials are resembling the characteristics (*al-tasyabbuh al-ma'nawi*) of the living pig and human, (ii) leading to the encouragement of approaching pig-based and human-based materials, and (iii) imitating the practices of the unbelievers (non-Muslims) who use pig-based substances.

Besides, the researcher is in the opinion that synthetic pig gene (which is produced after the process of chemical synthesis of DNA and it is in the type of tangible material) is considered impermissible (Haram) although it is synthetically constructed, and this is because of *sadd al-dhara'i'* (preventive measures) principle in Shariah law, in this case, it means to close the way that may lead to the encouragement of approaching pig-based materials by using synthetic pig derivative which, in turn, may lead to the confusion among the Muslim communities. The synthetic pig gene can be considered Haram *lighairibi* (prohibition due to the other thing) because of other prohibited factors, which are leading to the encouragement of approaching pig-based materials and imitating the practices of the unbelievers (non-Muslims) who use pig-based substances. On the other hand, the pig (*sus scrofa domestica*) as recipient organism in this production line is considered Haram *lizatibi* (prohibition due to its substance) because it is originally impermissible (Haram).

Plus, the Muslim scholars had agreed on the prohibition of the usage of impure (*najis*) materials, such as pig, as a medication purpose, but it differs on its permissibility due to necessity or emergency case, as for Shafi'i school of thought, the usage of bone that is considered impure (*najis*) in Shariah, is not allowed except in an urgent need and there is no other alternative from pure (*tabir*) sources that can be consumed (Al-Bakri, 2021). Majma' al-Fiqh al-Islami Rabitah al-'Alam al-Islami who had convened on 28 Rabi' al-Akhir until 7 Jamadil Awwal 1405H, had decided that the transfer of animal organs to humans must be from animals that are permissible and slaughtered in accordance with Shariah, otherwise, it is only allowed if there is an urgent need, nevertheless when there is a clash between prohibition and harm (*mafsadah*), this Islamic legal maxim must be taken into account (Al-Bakri, 2021): "When two harm (*mafsadah*) collides, then the greater harm is protected (avoided) by choosing a lighter harm" (Al-Suyuti, 1983), having said that, the transplantation of pig organs to humans is permissible provided that it is an emergency (*darurah*) case certified by medical expert, and there is no other Halal alternative, otherwise, the permissibility is nullified, nonetheless a pig organ that has been transplanted into a patient body, does not need to be replaced if it could be dangerous to the patient (Al-Bakri, 2021).

5.0 CONCLUSION

Al-Intiqal (the transition) is one of the alternative verification methods of Shariah law in determining legal rulings on some products. Because there is no explicit information concerning genetic modified technology in the Qur'an or Hadith, determinations of Halal must be backed by other considerations when examining the status of genetic modified products. Study shows that two divisions of *al-Intiqal* (the transition) can be applied within synthetically modified organisms (SMOs) productions, which are *al-Intiqal al-sahib* (the accepted transition) and *al-Intiqal al-fasid* (the damaged transition). Study concludes that DNA synthesizer as conversion agent within SMOs production process can be considered permissible (Halal), while synthetic spider silk is also permissible (Halal) as the raw material is considered pure and its transition process had completely occurred in Shariah, nonetheless humanized pig organ is impermissible (Haram) as the raw material and its recipient organism are impermissible (Haram) and its transition process had not completely

occurred in Shariah, except for emergency (*darurah*) case with some provisions. Nevertheless, laboratory works are crucial in establishing a rigorous elucidation on particular matters. The theory of *al-Intiqal* (the transition) is pertinent in solving contemporary challenges pertaining to the Halal status of some products in line with the scientific and technological advancements.

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Conflict of Interest

The authors declare no conflict of interest.

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