

Disinfectant Shortage: A Multicountry Comparison of Breweries and Distilleries Responses to the COVID-19 Pandemic

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Abstract

The COVID-19 pandemic has disrupted global supply chains for sanitization products. Since the spread of germs and viruses, including the novel coronavirus SARS-CoV-2, can be reduced by using disinfectants, the demand for sanitizers has dramatically increased, leading to supply shortages. The focus of this paper is to identify the legal statuses and manufacturing capacities of breweries and distilleries in Switzerland, Germany, and the United States, and this industry's response to the pandemic through supplying alcohol. We identify and compare the responses from each country and successful solutions to resolve the shortages. We mainly focus on how distilleries and breweries have adapted their production lines to produce disinfectants. This paper includes what the responses were and how changes were made. Our research has shown what measures the United States can adopt and how to move forward with meeting the demand based on successful case studies from Europe.

Keywords

COVID-19 pandemic, hand sanitizers, supply shortage, distilleries, multicountry comparison

1. Introduction

The COVID-19 pandemic has substantially increased the demand for disinfectants. The regular supply to the market is insufficient, and producers cannot raise their production capacities fast enough. As a result, new suppliers have entered the market, but for various reasons: some want to make a profit. Others want to cover their fixed costs (i.e., they do not have to file for bankruptcy). The third group of suppliers simply wants to help. Because of the varied motives, the following paper will shed further light on these motives and the methods of market entry, using specific examples from Germany, Switzerland, and the United States. However, it should also be mentioned that there are

many different approaches to the production of additional disinfectants in each country. This paper selects several case studies in each of the three countries and looks at their specific ways of producing additional disinfectant products. This paper starts with the two European countries, as the number of COVID-19 infections was higher in Europe in the early days of the pandemic compared to the United States.

2. Methodology

The authors collected both qualitative and quantitative data about the pandemic and the local responses in each country. An example of qualitative data is describing changes and impacts. On the other hand, exact production formulas and output is an example of quantitative data. Collecting both qualitative and quantitative data provides a more holistic overview of the state and scale of the situation to later compare across similar metrics. Thus, the authors decided first to survey breweries and distilleries in their respective local regions, asking questions about the impact COVID-19 has had on the companies, how they have responded, and what the result was. To further supplement the overview, the authors looked at published media and scholarly articles for facts and figures for various businesses. Once the data was collected, it was divided into legal and production changes by each country. With the different categories, they were discussed and compared with each other for each country, noting similarities, differences, and general trends across the three countries.

3. Legal Statutes

This section shows the different legal regulations of the countries under consideration, their particularities, and their differences.

3.1 Germany

The EN 14885 standard enables manufacturers, users, and responsible supervisory authorities to assess the effectiveness of chemical disinfectants and antiseptics. The EU standard EN 14885 places highly complex regulation on such disinfectant agents. EN 14885 contains many standards that define test procedures and approval requirements for these products. The European standard provides a good overview of the use of chemical disinfectants and antiseptics in all essential areas (Hyggen, 2020).

The production of disinfection by breweries had been made possible through a declaration made by the customs authorities. According to this announcement, untaxed and non-denatured alcohol (to let the pharmacists operate with less bureaucracy) may be used for the production of disinfectants from now on and is initially valid until May 31, 2020 (Vollmuth, 2020). The responsible Federal Institute for Occupational Safety and Health has already twice relaxed its specifications to produce disinfectants and expanded the circle of approved manufacturers. Now pharmacies, the pharmaceutical and chemical manufacturers, and "legal entities under public law" are allowed to produce disinfectants themselves according to precise specifications, for example, counties, municipalities, or even universities are all allowed to produce their own alcohol (Lenhardt, 2020).

3.2 Switzerland

Production of alcohol for drinking purposes (e.g., spirits) as well as placing on the market of disinfectants (e.g., hand sanitizers) in Switzerland are subject to licensing by the state.

Licenses for the production of drinkable alcohol are granted to either commercial, contract, or agricultural distillers. The produced potable alcohol is generally taxed with 29 Swiss Francs per liter (i.e., 112.91 USD per gallon). Drinkable alcohol is freed from taxes either in agricultural production, under special circumstances and limits, as well as when it is used for non-drinking purposes by registered manufacturers (e.g., pharmacies). If the alcohol is denatured with specific ingredients, it also is freed from taxation. Figure 1 gives an overview of the production paths for drinkable alcohol (Eidgenössische Zollverwaltung, 2020).

Selling disinfectants for personal hygiene purposes (e.g., hand sanitizers) and cleaning and disinfecting surfaces are subject to governmental regulations. The products need approval from notified bodies and are licensed individually (Gemeinsame Anmeldestelle Chemikalien, 2017).

Due to the COVID-19 pandemic, a shortage in alcohol-based disinfectants has occurred since the beginning of 2020. This shortage of supply resulted in a drastic rise in prices (Alcosuisse AG, 2020) The Federal Office of Public Health (FOPH) of Switzerland declared temporary easing of the above-described regulations for ethanol-based disinfectants on February 28, 2020. On April 9, 2020, the FOPH eased as well the rules to manufacture active-chlorine-based disinfectants, for example, bleach. Thereof the licensing of disinfectants was suspended until August 31, 2020, and production and placing on the market became open to anyone meeting specific requirements regarding ingredients, mixture, bottling, and denaturation. The compliance had to be provided through self-declaration by the producer (Gemeinsame Anmeldestelle Chemikalien, 2020). However, the licensed producers of drinkable alcohol could now apply to use their facilities for the production of alcohol in denatured or non-denatured form for either internal use or for the manufacturing of disinfectants to be sold on the market (Eidgenössische Zollverwaltung, 2020).

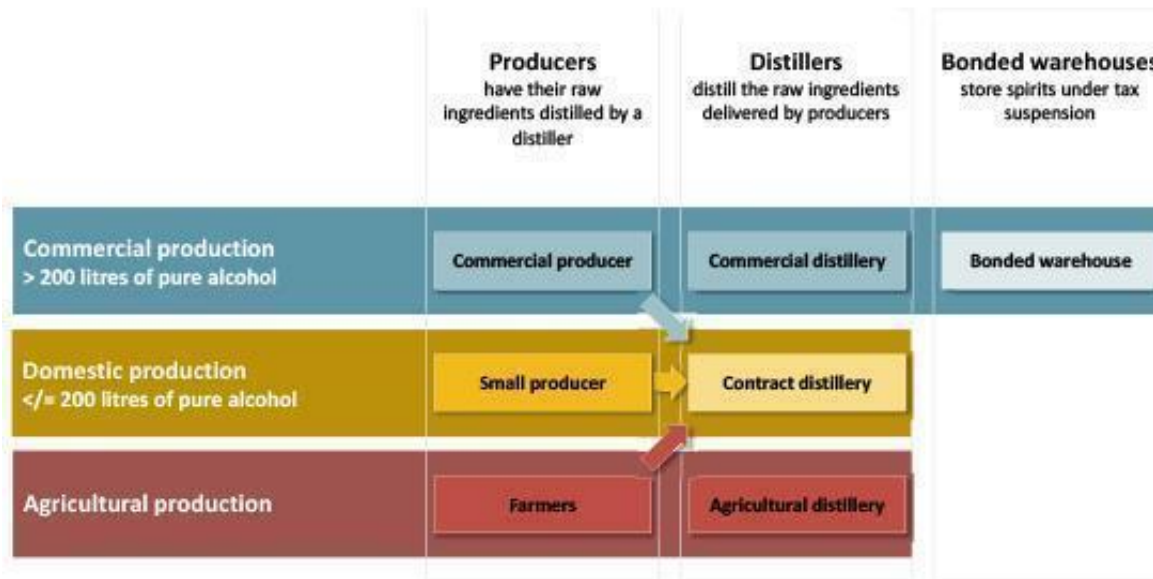


Figure 1: Production of drinkable alcohol in Switzerland (Federal Customs Administration, 2020)

3.3 The United States of America

Before the official changes to the law to relax and adapt it to the pandemic, the Alcohol and Tobacco Tax and Trade Bureau (TTB) and the US Food and Drug Administration (FDA) agencies held strict regulations on alcohol production. This limited production to companies with approved licenses. Despite this, distilleries without these granted licenses still produced small patches of alcohol-based products, such as hand sanitizer and disinfectants, to test their production and scalability. Some quietly produced non-denatured sanitizers as a donation to the local community and hospitals in need to circumvent restrictions and meet emergency demand. However, on March 19, 2020, the USA introduced the CARES and Economic Security Acts, which included aid and relief plans for the COVID-19 pandemic (FDA, 2020). Soon after, this would drive the FDA on March 20, 2020, to ease restrictions on alcohol production and to release new guidelines. On March 26, 2020, the TTB followed suit and eased restrictions (TTB, 2020). With fewer legal barriers, producers around the country ramped up their production. For examples of regulations and label requirements outlined in the release, see Figures 2 and 3 below.

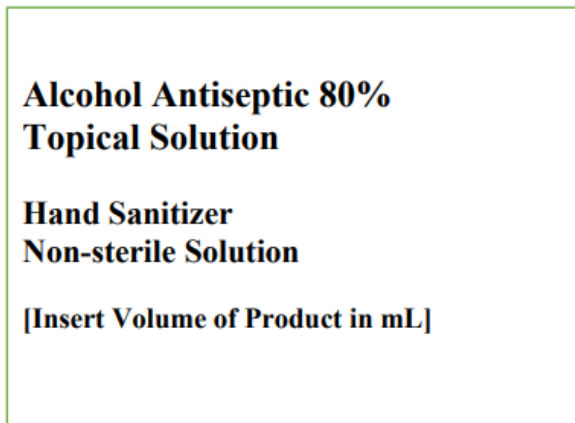


Figure 2: FDA Labelling for Ethanol Formulation Consumer Use (Principal front of package display) (FDA, 2020)

| | |
|--|----------------|
| Drug Facts | |
| Active ingredient[s] | Purpose |
| Alcohol 80% v/v..... | Antiseptic |
| Use[s] | |
| Hand Sanitizer to help reduce bacteria that potentially can cause disease. For use when soap and water are not available. | |
| Warnings | |
| For external use only. Flammable. Keep away from heat or flame | |
| Do not use | |
| <ul style="list-style-type: none"> in children less than 2 months of age on open skin wounds | |
| When using this product keep out of eyes, ears, and mouth. In case of contact with eyes, rinse eyes thoroughly with water. | |
| Stop use and ask a doctor if irritation or rash occurs. These may be signs of a serious condition. | |
| Keep out of reach of children. If swallowed, get medical help or contact a Poison Control Center right away. | |
| Directions | |
| <ul style="list-style-type: none"> Place enough product on hands to cover all surfaces. Rub hands together until dry. Supervise children under 6 years of age when using this product to avoid swallowing. | |
| Other information | |
| <ul style="list-style-type: none"> Store between 15-30C (59-86F) Avoid freezing and excessive heat above 40C (104F) | |
| Inactive ingredients glycerin, hydrogen peroxide, purified water USP | |

Figure 3: Drug Facts Label (FDA, 2020)

As for the FDA guidelines, they revealed that they would comply with the World Health Organization (WHO) guidelines too. Although WHO says denaturing is unnecessary, the FDA is not as lenient and requires manufacturers to denature their alcohol to make it non-consumable (FDA, 2020). However, distilleries fear that the denaturants will linger in the distillation process and affect the future production of regular alcohol when normal production is restored. According to the modified guidelines, the formula for producing alcohol requires 75% volume/volume percent (v/v) or 80% v/v ethanol (FDA, 2020). For the TTB relaxed measures, they suspended the excise tax for hand sanitizers when the product is denatured (TTB, 2020).

4. Production and Logistical changes

This section shows the different approaches of the breweries and distilleries under consideration and their specific characteristics. Special attention is given to the sales channels and the changes in the supply chain of the respective company.

4.1 Germany

Beck's brewery in Bremen, which was founded in 1873 and has nowadays around 1,500 employees, was bought in 2004 by the world's largest brewery group AB Inbev (Ab-inbev, 2020). Due to the changing circumstances and the high demand for disinfectants, Beck's brewery was one of the first breweries in Germany to use its know-how and

production capacities to counteract this bottleneck. They developed two different strategies on how to produce and distribute its own disinfectants, which are illustrated in Figure 4.

One strategy involves the use of excess alcohol from the dealcoholization of alcohol-free beers such as Beck's Blue and Jupiler 0.0%. "The changeover from brewing with hops and barley to the production of disinfectants and hand disinfectants was a challenge, but one that we were happy to take up in view of the current situation," says Jason Warner, European head of AB Inbev. So, they use alcohol produced during the dealcoholization process. This alcohol is then given in larger containers to pharmacies, which use it as a primary substance for mixing disinfectants on their own premises. Theoretically, it is not difficult for a pharmacist to produce disinfectants themselves. A mixture of alcohol and water would be enough to achieve a disinfectant effect. But often, a recipe that was published by the WHO is used. According to this formula, hydrogen peroxide and glycerin are also added to the disinfectant (Lakeband & Hanuschke, 2020). The brewery donated these large quantities of excess alcohol as well to the disinfectant manufacturer KWST GmbH in addition to local pharmacies. The company has supplied a total of 500,000 liters (132,086 gallons) worth 1.5 million euros or \$1.67 million USD free of charge to KWST as of March 24, 2020 (Fischer, 2020). With this strategy, the brewery does not want to make profits or think in terms of costs. The company is just aiming at contributing to the common fight against the pandemic.

The other strategy that Beck's currently pursues is the in-house production of finished disinfectant. The brewery has been producing this for its own needs for a long time. Their plant is currently running at full capacity and can, therefore, produce up to 500 liters (132 gallons) of disinfectant per day. Employees then fill this into converted 0.5-liter (0.13 gallon) beer bottles, labeled and sold at cost price. Thus, the brewery is once again doing something good, but at the same time, it can also pay for the staff and materials used.

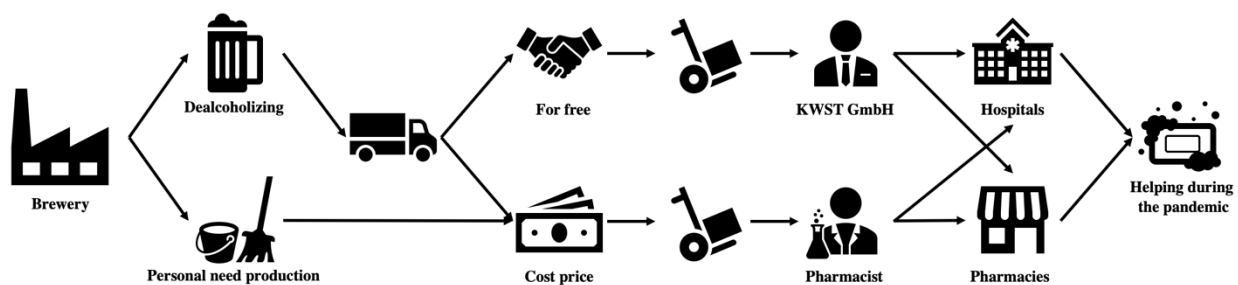


Figure 4: Beck's disinfectant supply chain

Due to the complex regulations, there are only a few specialized companies in Germany that can produce and market disinfectants. The sharp increase in demand triggered by the COVID-19 pandemic has, therefore, led to bottlenecks. This is, therefore, not exclusively due to the procurement of raw materials, but much more to the legal regulations and the associated production capacities of the relevant manufacturers. The Federal Health Ministers, who involved the industry in crisis management at an early stage, reacted well to this situation. They promised to work towards adapting regulations at short notice or creating exceptions to ensure the availability of disinfectants. However, these adjustments to the rules still took time, so that the measures described above were only able to take effect somewhat later than the enormous demand for disinfectants. As a result, there were substantial price fluctuations in the market. Panic buying by the population made the situation worse. In the course of this, a discussion also began in Germany as to whether the production of essential drugs and raw material reserves should be relocated back to Germany so that in the event of another pandemic, one can act faster and be less dependent on partner countries and foreign suppliers (Freytag, 2020).

4.2 Switzerland

In the authors' study of the Swiss case study, two different companies with two different approaches are considered at first, succeeded by an overview of the general situation among alcohol producers in the country.

4.2.1 Brauerei Locher AG (Brewery / Distillery), Appenzell (AI)

Brauerei Locher AG is a brewery located in eastern Switzerland, mainly known for its beer-brand "Appenzeller Bier" that has been established in 1810 and is owned by the Locher family since 1886. With about 90 employees, the company produces 14 million liters (3.7 million gallons) of beer per year. The company's product assortment has

around 37 variations of beer, including non-alcoholic beer, and whiskey that gets produced in the company-owned distillery (Brauerei Locher, 2018; Brauerei Locher, 2020).

The authors conducted an interview with Aurèle Meyer, director of Brauerei Locher AG, on May 7, 2020. The company stepped in early when shortages of disinfectants and alcohol occurred and quickly got approval when the government declared the temporary deregulation. Therefore, they started to use their brewing and distilling facilities for sustaining the production of alcohol and disinfectants.

The raw material used came from various supplies: beer from stock (i.e., beer usually stocked for one month) and barley for its production was used due to the dropped demand from the gastronomy sector. Furthermore, the company repurchased inventory from their customers at a cost-covering price who otherwise would have been forced to throw it away due to the COVID-19-related temporary closures.

The production facility is typically used to produce whiskey and did not have to undergo technical changes due to the change of product. The short-term change did not affect the whiskey production because it usually is not or only sparsely produced during spring and summer, and there are large amounts of stock (e.g., whiskey is usually stocked for four years).

At the time of the interview, the company had produced 5,000 liters (1,321 gallons) of disinfectants in-house and 30,000 liters (7,925 gallons) of alcohol for further external processing. On the company's web blog, a post stated that 1,000 liters (264 gallons) of alcohol had been donated to the canton of Appenzell Innerrhoden (Tanner, 2020)

Financially the endeavor is cost-covering but not profitable. Profit was never targeted by the company whose interest mainly was to sustain their long-term relations to customers and to help fight against the shortages in supply for health services and the public. As an outlook, the director stated that they would go on producing alcohol and disinfectants as long as it is permitted. Figure 5 illustrates the production and distribution paths for alcohol and disinfectants associated with Brauerei Locher.

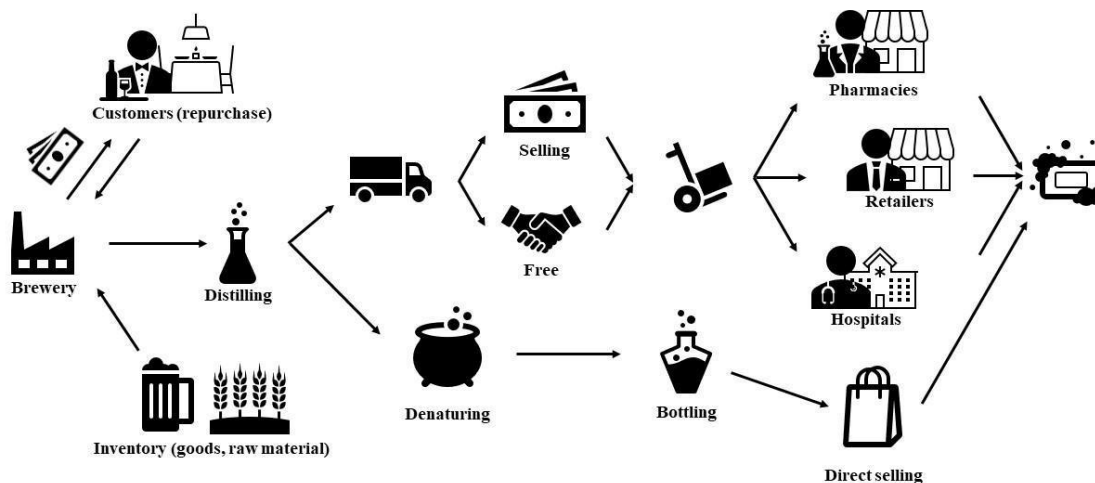


Figure 5: Brauerei Locher's disinfectant supply chain

4.2.2 Rugenbräu AG (Brewery / Distillery), Matten bei Interlaken (BE)

Rugenbräu AG is a brewery producing 8 million liters (2.1 million gallons) of beverages, including 4 million liters (1.1 million gallons) of beer. The company was established in 1866, employs around 60 people, and produces about 13 variations of beer, including non-alcoholic, whiskeys, gin, and other spirits, as well as wine and mineral water (Rugenbräu, 2018; Rugenbräu, 2020).

The authors conducted an interview with Remo Kobluk, CEO of Rugenbräu AG. The company started to produce alcohol for further processing to disinfectants through pharmacies and hospitals soon after the supply shortages emerged. Production is at a capacity of 100 liters (26.5 gallons) per day and remained at that level since the start. The CEO stated that after several weeks, the production of the regular producers of alcohol for medical purposes had been ramped up. The production at Rugenbräu does not affect the distilling of whiskey and gin because they usually are not continuously produced. Therefore the temporary change fitted in the schedule without disruptions. The raw material used is mainly stocked beer and beer that has been sent-back from customers due to low demand, as well as mulled wine from stock. Financially the endeavor does not pay off, which was never pursued. The purpose was always to sustain health services and to avoid food waste. Overall, the production is cost-covering. Figure 6 illustrates the supply and production paths for the production of disinfectants associated with Rugenbräu.

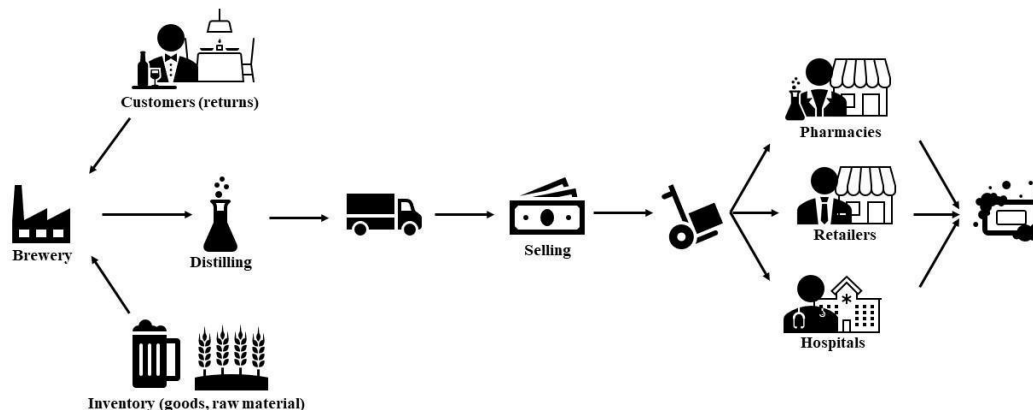


Figure 6: Rugenbräu's disinfectant supply chain

The import of alcohol in Switzerland was subject to a monopoly held by the government until January 1, 2019. In the course of liberalization of the ethanol market, the state-owned importer, the Swiss Alcohol Board, was privatized into the *alcosuisse ag*. (Der Bundesrat; Eidgenössische Zollverwaltung; *Alcosuisse*, 2018) The company imports and processes raw alcohol for industrial as well as drinking purposes. (*Alcosuisse ag*, 2020) Due to the COVID-19 pandemic shortages for industrial alcohol as a basis for disinfectants occurred all over Europe. *Alcosuisse* ramped up their production by 60% to meet the high demand, mainly caused by health services. (Mathis I, 2020)

Newspapers reported that compulsory stockpiling of ethanol for times of crisis had been neglected by the Federal Office for National Economic Supply. Additionally, in the wake of privatization, 8,000-10,000 metric tons of compulsory held stock at *alcosuisse ag* had been dissolved. It is thought that the shortage could have easily been prevented with such amounts of stocked ethanol, easing the dependency of Switzerland from foreign producers (Lenz & Reichen, 2020).

Newspapers all over Switzerland reported that a large variety of distilleries in Switzerland started to produce alcohol for disinfectants. The motives for doing so can be summarized as an attempt to support health services (e.g., hospital, elderly care, retirement homes, pharmacies, etc.) as well as the public, prevention of food waste, financial harm reduction due to suspended demand and helping customers in the supply chain. From a supply chain perspective, the two portrayed breweries used inventory (beer, wine, barley) to prevent it from decay and inverted the downstream supply chain by taking back goods from customers for further processing (*Desinfektionsmittel statt Schnaps*, 2020; *Devenish*, 2020; *Dürrenberger*, 2020; *Griesser Kym*, 2020; *Hämmann*, 2020; *Wälter*, 2020).

Some distilleries used their long-term safety stock of alcohol in case of failed harvest in addition to the raw material for spirits (e.g., apples, pears, cherries, etc.). Distillers stated that they have trouble with the decision to support the public and health services by using their high-quality products for inferior use, calling the changeover a risk to their reputation as a manufacturer of luxury products (Mathis II, 2020).

4.3 The United States of America

First, the Portuguese Bend Distilling company was investigated, based in Long Beach, California. According to the Los Angeles Times article (Branson-Potts, 2020), which interviewed the workers, they said that for their production, they expanded the capacity by contacting other distilleries nearby to coordinate resources. The company also converted all its production processes from alcohol into hand sanitizer production. At the time, they were producing 379-569 liters (100-150 gallons) of hand sanitizer per week but projected to ramp up by two or three times. Unfortunately, they struggled with production because there was a shortage of containers.

As for the management of the company, the days of the week were changed and separated so that all transferring, brewing, fermenting, and shipping would occur on certain days, thereby decreasing changeover time. Additionally, the entire front of the store (i.e., servers, chefs, and staff) were furloughed, leaving only the skeleton crew for the production behind the company site to remain.

The article further goes on to clarify the production process used at this location. First, the producer starts with corn as the base and boil it. Then, in the fermenter, workers use yeast as a catalyst to fully ferment the wort before it then produces sought-after alcohol. Once fully fermented, the wort is moved to the still, in which it is boiled at 85-88 °C (185-190 °F). This process separates the water from the alcohol, concentrating the mix. This is the ideal temperature range since the alcohol would boil off first at 85 °C (170 °F), leaving the water, which boils at 100 °C (212 °F), behind. Then, the alcohol vapor is piped to the still, where it continually condenses to concentrate to produce the targeted

+95% ethyl alcohol. Then, workers transfer the alcohol into plastic containers, where they can denature it by adding acetone methanol or isopropyl (which are active ingredients). After that, the alcohol runs through the filter columns and copper bubble plates. These channels cycle alcohol through at 20% alcohol until it turns then into purer ethanol. This happens because heavier molecules are held back during the cycles. The alcohol condenses at the end at a temperature of 16 °C (60 °F), and then it is checked for the alcohol content. Finally, to give the antibacterial property, workers add hydrogen peroxide and glycerin, which enables the disinfectants to now kill off SARS-CoV-2, the virus that causes the COVID-19 disease (Branson-Potts, 2020). Refer to figure 7 below for a summarization of the distillation process.

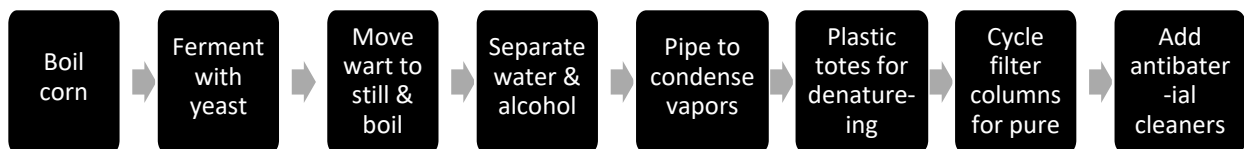


Figure 7: Portuguese Bend Distilling Co. production process

Meanwhile, at Black Button Distilling and Lexington Brewing & Distilling companies, they have taken a slightly different approach to meet the demand for disinfectants. In terms of production, the companies had to fundraise for the equipment and supplies, because they did not have them readily available. In these two cases, the companies also preemptively shut down their facilities completely, despite the problematic startup time and costs, to ensure proper state safety mandates and health protocols. They were worried that the fermentation and distillation processes take time to wind down too.

However, once the production was back online, they were reaching a capacity of 30,000 750 ml (25 oz) bottles per week (Abesamis, 2020). Like many other businesses, they had to test batch to prepare for the change and immediately order packaging in the first days after the regulation changes to fully ramp up production. Additionally, they also drew upon their in-stock alcoholic beverages, converting some of them into disinfectants to further speed up the transition.

The authors had the chance to speak to Joshua Grassel, an intern at the California-based E&J Gallo Winery, and he was able to provide information about what has changed since the start of the COVID-19 pandemic. He discussed four main changes caused by the coronavirus: 1) increased demand; 2) reduced workforce, 3) safety measures; and 4) working from home. Gallo has several brands of gin, tequila, and pre-mixed drinks. These all have experienced a massive spike in sales. Tequila, for Gallo, is either all or mostly imported as a finished bottle. Imports are harder to handle as their cardboard is cheaper, smaller in pattern sizes, are not packed as efficiently, and the slip sheets they put between layer messes with automation and cause problems. During this pandemic, Gallo has reduced the workforce by increasing available sick leave and letting employees use sick leave from the next year's balance.

More people are taking time off, and sales are increasing, so operations are bustling. This is leading to more overtime and increasing the importance of keeping all automation running without downtime. Safety measures have been implemented over the past couple of months. Forklifts must be sanitized before and after use, sanitizing all conference rooms before use, and masks are required when not in your office. This has caused minor delays, but nothing too significant. Working from home has made it harder to communicate on a quick basis. An engineer, typically knows the tech inside and out, can watch, see a problem then fix it. Now the workflow is, when someone sees a problem, they need to get running immediately, so they try to fix it, possibly breaking it further. Now they report in a lengthy email what happened, what they did, and where it is now. Then their engineer tries to interpret that, describe how to fix it, later they try to fix it. There is so much potential for miscommunication in the current system. Turnaround times for problem fixes on the equipment are considerable. Some problems take weeks that would typically take two or three hours.

Another distillery the authors looked at is Cotton and Reed in Washington, DC. Since Cotton and Reed is a craft brewery and not a large-scale commercial one, they had an easy time adapting to making disinfectants. With their large amount of stock from production before the breakout of the pandemic, they were able to test in small batches to perfect their disinfectant before mass production (Balaban, 2020). Also, with them being a smaller craft distillery, they had a smoother transition to making disinfectant because they have lower demand than larger commercial distilleries. Generally, management for the various distilleries and breweries has laid off many of their workers, leaving behind the essential skeleton workforce. Despite this, there have been varied responses to their capacity. While some have slimmed down their production to focus on the disinfectant and alcohol or reduced their production to meet fixed costs, some others have ramped up their production to exceed and even profit from the increased demand. However, these are uncommon. In general, the overall capacity of the distilleries has gone down.

Another trend that was noticed was that before the legal changes, many companies were faced with the tough decision to either fully shutdown their operations or test the new alcohol production methods. Many tested the feasibility of the project by producing samples of the product. Once proven successful, they continued to order supplies and ramped up production once the legal restrictions were lifted, functioning as their primary production item.

For general trends in the production process of these disinfectants, there are two main approaches: recycling their available, on-hand alcohol, or focusing on implementing the full production from raw material. Although processes vary, it often begins with grains, which are boiled to a slurry. The wort is extracted, which contains sugars. Then, to ferment the mixture, yeast is added and left to ferment. Once complete, the mix is moved to a still, in which the device distills it into the alcohol. However, it is necessary to then denature the alcohol by adding acetone or methanol, which puts off a bad taste and is poisonous to consume. Finally, the alcohol is continually cycled to condense, evaporate, and thereby separate from the water and concentrate before the antiseptic agents (hydrogen peroxide and glycerin) are added. These chemicals are what give the antibacterial properties for the alcohol-based disinfectant.

5. Overall comparison

On a global scale, the United States was hit by COVID-19 after a lot of other places. Europe was about two to four weeks ahead of the United States in dealing with the pandemic. Since Europe was hit before the United States, they are ahead of the United States in the fight against the coronavirus. The European case can be used to help the United States learn how to handle the pandemic. One way Europe can be used as an example for the USA is how European countries dealt with the shortage of disinfectants available to the general public.

Countries like Germany and Switzerland have allowed the production of disinfectants by breweries, subject to government regulations to counteract the shortage of disinfectants and the rise of their prices. The United States has recently followed Europe's path and is slowly allowing breweries to help produce disinfectants under guidelines set by the Alcohol and Tobacco Tax and Trade Bureau.

Europe is ahead of the United States in four areas: 1) relaxing physical distancing in stages; 2) tracking the spread of the disease better through improved testing and contact tracing; 3) managing health systems; 4) putting in place social and economic policies to support the transition. France is using a sort of "traffic light" to indicate how prevalent the coronavirus infection is in a particular area. Red areas are still locked down, and the green areas have looser restrictions. Germany is currently conducting a large number of tests to get an accurate picture of the virus. They are also assigning a five-person team for every 20,000 people for contact tracing the virus to see what communities are affected the most. European governments exert more control over the health systems than the United States. Governments in Europe can now decide when nonessential operations and treatments can resume. European governments are facilitating discussions between employers and employees, ensuring income replacement for people who can't work due to physical distancing requirements (Jarman, Rozenblum, Greer, 2020).

The United States is trying to increase tests and tracing. The American healthcare system is also filled with private providers with less government control. The United States has also just started relaxing some of the distancing requirements in the country. The USA has also lacked on the social policy front as well. There is an unemployment payment system in place for people out of work due to the virus. Still, it is only in payments of \$1,200, while the European alternative has some countries are paying percentages of salaries of the previous year for people.

If the United States were to consider these strategies, the economy could be opened quicker and possibly return to normal quicker as well. The number of virus cases and deaths can go down as an effect of testing and tracing more people. It would allow the United States to target areas that are profoundly affected by COVID-19 and slowly open up the areas that are not affected by the virus.

6. Study Issues

Due to time constraints and company privacy, common metrics of either qualitative (e.g., production rates per week) or quantitative (e.g., exactly department or machinery changes) data could not be collected to ensure a comparison that is consistent and relevant across the board. Therefore, this paper limited to providing what data is that was publicly and readily available, which is the authors considered to be the best route given the restrictions to collect information. Without being able to gather common specific statistics across the companies, this does leave holes within the comparative calculus. However, the varied sources and more general qualitative description of the changes and outcomes can be sufficient to instead offer an understanding of the situation from a broad point of view with various facets of solution possibilities. Prospective readers should then decide if this information is appealing and relevant for their specific needs.

7. Further Research

To better understand the changes that enabled production changes, encouraged specific changes, and the quantitative result and impact, further research should be carried out. Specifically, researchers should consider the market conditions of the country, region, or business line. Additionally, if there were more data readily available from companies about their production rates before the changes, that would help better compare the aftereffects. Of course, analyzing the many changes each company made and their factors would be of use too. Finally, the authors recommend collecting more data on the production and sales from the companies after they had begun to produce more disinfectants. However, this naturally requires more time for the production to amass more data to start to build a trend across such a vast set of comparative points (e.g., countries, different alcoholic businesses, and individual businesses).

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